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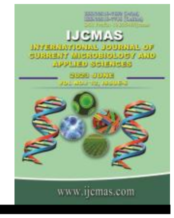

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Influence of Seed Enhancement on Seed Growth and Yield Parameters in Paddy cv. IR 64

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A B S T R A C T

The experiment was conduct to investigate the influence of seed enhancement on growth and yield in paddy plants in during 2021-2022 at Department of Agricultural Engineering, Rathinam Technical Campus in Coimbatore. Paddy cv. IR 64 was used for these experiments. Under experiment, various inorganic and organic treatments such as 1% $CaCl_2$, 1% KCl, 1% KNO_3, 1% NaCl, 10% Cow dung, 3% panchakavya were applied to investigate growth and yield in rice seedlings. Among all hardening techniques, seed hardening with 1% $CaCl_2$ showed the performances. Seed hardening with 1% $CaCl_2$ increased in seed quality, growth and yield when compared to control. Therefore this study concludes that seed hardening with 1% $CaCl_2$ be employed for better crop growth of rice.

Introduction

Rice (*Oryza sativa* L.) is one of the staple food crops in South and Southeast Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. It is estimated that 40% of the world's population use rice as a major source of energy.

Globally, rice ranks second only to wheat in terms of area harvested, but in terms of importance as a food crop, rice provides more energy per hectare than any other cereal crops. For almost three decades since the "Green Revolution", the rice yield growth rate was approximately 2.5% per year. During the 1990s, however this has decreased to only 1.1% (Riveros and Figures, 2000). India ranks first in area and second in production. In India, Rice was cultivated in an area of 46 million hectares with a production of 125MMT and productivity of 4.08 metric tons per hectare (World Agricultural Production, Anon, 2017). In India, nearly 70 per cent of cultivated land is rainfed, but accounts for about 42 per cent of the total quantity of produced food grains. Quality seeds play a major role, along with improved package of practices leading to enhanced productivity. The low productivity under rainfed condition is due to use of poor quality seeds, soil moisture deficit, low and erratic rainfall and improper crop management.

Seed hardening will modify the physiological and biochemical nature of seeds, so as to get the characters that are favourable for drought tolerance. Although, it varies from crop to crop, the principle remains same. When dry seeds are soaked in water/chemical solutions, the quiescent cells get hydrated and germination initiated. It also results in enhanced mitochondrial activity leading to the formation of high energy compounds and vital biomolecules. The latent embryo gets enlarged. When the imbibed seeds are dried again, triggered germination is halted. When such seeds are sown, re-imbibitions begins and the germination event resumes from where it previously ceased (Sujatha *et al.,* 2013).

The principle guidelines for organic production are to use materials and practices that enhance the parts of the parts of the farming systems into an ecological holistic system. Organic seed hardening provides hardiness to high temperature, low moisture especially in semi arid tropics. It promotes faster germination, higher seedling vigour leading to higher crop productivity. The main benefits of organic seed treatments include increased phosphate levels, nitrogen fixation and root development.

Materials and Methods

Genetically and physically pure seeds of paddy cv. IR 64 were obtained from the Tamil Nadu Rice Research Institute (TRRI), Aduthurai, for this study. Field experiments were carried out at Department of Agricultural Engineering, Rathinam Technical Campus during the year 2021-2022. Laboratory analysis was conducted at Post Harvest Technology Laboratory, Department of Agricultural Engineering in Rathinam Technical Campus. The Post Harvest Technology Laboratory was situated at $10^0$932’ North latitude and $76^0$977’.

Climate and Weather

The weather at Rathinam Technical Campus is moderately warm with hot summer months. The mean maximum temperature fluctuates between 31.2^0C and 32.3^0 C with a mean of 31.99^0C while the minimum temperature ranges from 22.9^0C to 23.6^0C with a mean of 23.25^0C. The relative humidity ranges from 76 to 96 percent with a mean of 86 per cent. The mean annual rainfall received was 72.55mm with a distribution of 1000 mm during North East monsoon, 400 mm during the South West monsoon and 100 mm during hot weather period spreaded over 112.27 rainy days (30.76% of the time) annually.

Soil characteristics

The soil of the experimental field was Red Calcareous soil with a pH of 9.25 and EC of 0.02 (dSm^{-1}). The soil was low in available macro-nutrients as nitrogen, phosphorus and high in available potassium in paddy field.

Seed hardened plant might survive adverse environmental stresses more easily because of its advanced state of development a day before sowing, fresh seeds of paddy varieties *cv*. IR 64 soaked in the respective solutions for 12 h in 1:1 proportion for hardening purpose. Later, seeds were dried back to 10 per cent moisture content under shade and dibbled.

Treatments details

T_0 - Control
T_1 - 1% $CaCl_2$
T_2 - l% KCl
T_3 - 1% KNO_3
T_4 - l% NaCl
T_5 - 10% Cow dung
T_6 - 3% Panchakavya

The recommended package of practice was followed for raising the crop. The seeds were subject to evaluation in both laboratory and field experiment. In laboratory experiment (completely randomized design) the treated seeds were shade dried to the original moisture content of 10 per cent and then the seeds were evaluated for their performance in initial seed quality parameters. The field experimental trial was conducted in a Randomized Block Design replicated thrice. The treated seeds were sown in raised nursery bed. Twenty five days old seedlings were transplanted to the main field at the rate of one seedling per hill with the spacing of 15 cm between rows and 10 cm within plants. Recommended cultural practices were followed and then the seeds were evaluated for their performance in growth and yield parameters.

Statistical analysis

The date collected from the field and laboratory experiments were analysed statistically by adopting the technique described by Panse and Sukhatme (1985). Wherever necessary, the values expressed in percentage were transformed into Arc sin values before analysis. The significance of treatment effect was tested with the help of F-test and the differences between treatments by Critical Difference (C.D) at 5% level of significance were determined.

Results and Discussion

The present study was under taken to observe the effect of various seed treatments on yield and its contributing characters in IR 64.

To study the effect of following seed treatments namely 1% $CaCl_2$, l% KCl, 1% KNO_3, l% NaCl, 10% Cow dung, 3% Panchakavya, under laboratory and field conditions during the year 2021-2022. The results of the various treatments are discussed below.

The reason for higher germination percentage and rate may be due to greater hydration of colloids, higher viscosity and elasticity of protoplasm, offer an increase in bound water content, lower water deficit and increased metabolic activity (Maitraa *et al.,* 1999).

Higher germination per cent in T_1 may be due to the benefits of hardening which may be due to number of physic chemical changes occur that modify the protoplasmic characters, increasing the embryo physiological activity and associated structures (Ganesh *et al.,* 2013). Since, $CaCl_2$ improving cell water status and also act as cofactors in the activities of numerous enzymes (Joseph and Nair, 1989) most of which are active when reserve metabolization and radical protrusion were in progress.

Subsequent improved in germination and speed of germination T_1 of the hardened seed could be due to the fact that such advanced seed would retain viability to carry on where they left off upon germination (Joseph and Nair, 1989; Rangaswamy *et al.,* 1993).

This might be possible due to an exhaustive utilization of amylase enzyme activity during the early and enhanced rate of germination in hardened seeds as compared to control. The increased activity of amylase further established a positive correlation with the increasing amount of soluble sugar (Kamalam and Nair 1989; Farooq *et al.,* 2010).

The present study revealed that the hardened seeds gave a maximum dry weight when compared to control which produces the minimum dry weight. The increased dry matter production over the control might be due to simultaneous effect of repair mechanism induced by hardened and synchronized earlier germination that makes seedling entry into the autotrophic state well in advance to produce more photo assimilate from source to sink there by increases the dry matter production. This was in conformity with earlier work of Shah (2007).

Higher seedling vigour index increased over was recorded by T_1 over control was due to the increased germination percentage of root length, shoot length and dry matter production of seedlings. $CaCl_2$ treatment seeds showed the increased seedling quality which may be due to the benefits effects of $CaCl_2$ in strengthening the cell membrane integrity and permeability. Chrysiansen and Foy (1979); Hecht –Buchholz (1979) reported that seed calcium concentration and germination percentage were positively correlated which suggests the role of calcium as an important in membrane stabilization and as an enzyme co-factor. The $CaCl_2$ activities the synthesis of protein and soluble sugar in first phase of germination which have advantages for earlier germination and in turn produces longer seedlings there by increases the vigour of seedling (Singh and Verma 1996; Farooq *et al.,* 2006a; Mulsanti and Wahyuni, 2011).

Among the treatments, T_1 (1% $CaCl_2$) treated plants completed days to 50% flowering with in short duration, when compared to other treatment and control. This positive reduction in days to 50% of flowering is mainly due to the earlier and uniform emergence of seedlings, which was evident from the present study and might be also due to the role of calcium in plant growth and development (Pawar *et al.,* 2003). The treatment T_1- 1% $CaCl_2$ recorded the more number of productive tillers per plant and it *cv.*IR 64 improvement over control which might may be due improved mobilization of nutrient and moisture supply from hardened seeds and might have resulted enhanced fertilization, which ended in lower number of sterile spikelet's as reported by Thakuria and Choudhary (1995); Rehman *et al.,* (2011); Patil *et al.,* (2014); Roohul Amin *et al.,* (2016).

The untreated seeds T_0 the plant registered the reduced plant height. The mechanism of reduction in plant height may be due to the reduced cell size, cell thickening, reduced rate of enzyme activity and poor availability of nutrients to the growing seedlings which favours delayed emergence and reduces vigour (Karivaratharaju and Ramkrishna, 1985; Patil *et al.,* 2014).

Among the treatments, T_1 registered the more value of panicle length, leaf length and leaf breadth over treatment and control. The improvement in vegetative growth parameters might be due the cumulative effect of hardening and $CaCl_2$ could have triggered the biosynthesis of nucleic acids, proteins and the consequential enhancement of cell division besides the enhanced metabolic activity of the plant resulting in the increased uptake of nutrients which are associated with improved crop growth (Jegathambal, 1996; Pawar *et al.,* 2003).

It might be due to the role of calcium involvement increased cell division strengthening of cell wall and cell enlargement which have a plant growth promoting capabilities and often applied as exogenous plant growth enhances (Maeshima, 1990; Magome *et al.,* 2004; Muhammad Aamir Iqbal *et al.,* 2014).

It might be due to hardening treatment that triggers metabolic activities proceed to repair and build up of nucleic acids, increases synthesis of proteins as well as repair membranes and enhances the activities of anti oxidative enzymes which favours enhanced to growth capability on tolerance of unfavourable condition (Sen and Osborne, 1974; Sharrir, 1978).

The probable reasons for improvement in yield attributes in number of seeds per panicle, seed yield per plant and harvest index might be due to the hardening chemicals which accelerate the synthesis of protein and nucleic acid bound water content and repair germination and growth of seedling resulting in increasing uptake of nutrients and ability of treated plants to unfavourable condition when compared to control.

The improved weight (100 seed weight) from the T_1 hardened seeds might be results of improved photo assimilation and its translocation and partitioning from sources towards the sinks (Narayanaswamy and Shambulingappa, 1998; Ananda and Reddy, 2002; Zheng *et al.,* 2002; Solaimalai and Subburamu, 2004).

Improved seed yield by T_1 as compared to the control and result of improved number of productive tillers (fertile tillers) and increased seed per panicle as evident from the present study. Similar results were reported by Lai and Luo (1989); Ponnuswamy (2005); Paramasivam *et al.,* (2007); Rehman *et al.,* (2011); Sujatha *et al.,* (2013); Patil *et al.,* (2014).

Table.1 Effect of seed enhancement treatment on initial seed quality parameters in rice *Cv.* IR 64

Treatments	Germination percentage (%)	Speed of germination	Root length (cm)	Shoot length (cm)	seedling length (cm)	Dry matter production (g seedling^{-10})	Vigour index I	Vigour index II
T_0	81(64.16)	25.40	16.06	10.60	27.20	0.3500	2203.20	28.35
T_1	93(74.68)	31.37	18.03	13.13	31.16	0.3867	2907.22	35.34
T_2	91(72.54)	30.84	17.40	12.86	30.26	0.3800	2753.65	34.58
T_3	90(71.56)	29.26	16.43	11.43	27.86	0.3700	2507.39	32.40
T_4	88(69.73)	28.26	17.06	11.90	28.96	0.3700	2548.48	32.56
T_5	85(67.21)	27.29	16.30	10.96	27.26	0.3767	2317.10	31.45
T_6	86(68.03)	26.21	16.33	11.00	27.33	0.3700	2350.38	31.82
Mean	89(69.70)	28.37	16.80	11.70	28.57	0.3719	2512.49	32.35
SEd	0.4878(0.4459)	0.1623	0.1671	0.0803	0.2974	0.0025	6.5506	0.0650
C.D(P = 0.05)	1.0487(0.9586)	0.3490	0.3593	0.1726	0.6394	0.0054	14.08	0.1397

Table.2 Effect of seed enhancement treatment on growth parameters rice *Cv.* IR 64

Treatments	Days to 50 per cent flowering	Number of tillers	Plant height (cm)	Number of productive tillers/plant
T_0	65.20	25.20	72.20	18.20
T_1	59.33	28.00	77.60	23.80
T_2	59.36	27.20	77.06	22.20
T_3	61.88	25.80	76.20	19.80
T_4	61.68	26.00	75.10	19.80
T_5	62.45	25.60	74.60	19.60
T_6	61.78	21.40	73.50	19.60
Mean	61.81	25.60	75.18	20.28
SEd	0.0104	0.0526	0.2015	0.0735
C.D (P = 0.05)	0.0226	0.1148	0.4393	0.1602

Table.3 Effect of seed enhancement treatment on growth parameters in rice *Cv.* IR 64

Treatments	panicle length (cm)	leaf length (cm)	leaf breadth (cm)
T_0	23.20	28.36	0.90
T_1	26.90	33.76	1.10
T_2	26.60	33.10	1.10
T_3	24.40	31.82	1.00
T_4	25.42	32.10	1.10
T_5	24.40	31.22	1.00
T_6	24.00	30.34	1.00
Mean	24.99	31.52	1.03
SEd	0.1095	0.3180	0.2429
C.D (P = 0.05)	0.2387	0.6932	0.5295

Table.4 Effect of seed enhancement treatment on yield parameter in rice *Cv.* IR 64

Treatments	No: of seeds per panicle	100 seed weight (g)	seed length (mm)	seed breadth (mm)	seed L×B ratio
T_0	82.50	1.93	8.50	2.20	18.70
T_1	111.50	2.06	8.87	2.60	23.06
T_2	96.00	2.03	8.87	2.30	20.40
T_3	88.50	2.00	8.62	2.30	19.83
T_4	91.00	2.03	8.62	2.30	19.83
T_5	86.00	2.00	8.62	2.30	19.83
T_6	84.50	1.96	8.62	2.30	19.83
Mean	91.43	2.00	8.67	2.33	20.21
SEd	0.7057	0.0104	0.0847	0.1198	0.7618
C.D(P = 0.05)	1.5385	0.0226	0.1847	0.2611	1.6608

Table.5 Effect of seed enhancement treatment on yield parameters in rice *Cv.* IR 64

Treatments	seed yield per plant	Fresh weight (g)	Dry weight (g)	harvest index
T_0	20.56	65.00	34.75	33.90
T_1	28.86	115.50	62.40	88.00
T_2	28.60	109.00	61.35	86.20
T_3	23.76	92.50	52.20	46.10
T_4	22.50	106.00	61.00	51.40
T_5	24.96	88.00	60.10	35.10
T_6	21.70	83.00	47.70	46.10
Mean	24.42	94.14	54.21	55.26
SEd	0.0735	1.1746	0.3077	0.6425
C.D(P = 0.05)	0.1602	2.5606	0.6708	1.4007

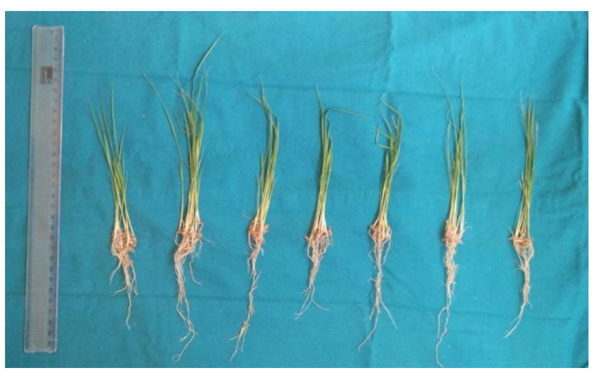
Table.6 Effect of seed enhancement treatment on resultant seed quality in rice *Cv.* IR 64

Treatments	Germination percentage (%)	Speed of germination	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Dry matter production (g seedling^{-10})	Vigour index I	Vigour index II
T_0	82(64.90)	26.72	16.46	10.96	27.42	0.3700	2248.44	29.52
T_1	95(77.08)	32.25	18.43	13.60	32.03	0.3900	3042.85	36.10
T_2	93(74.66)	31.03	17.83	13.06	30.89	0.3867	2872.77	35.34
T_3	92(73.57)	30.35	16.70	11.66	28.36	0.3700	2609.12	34.04
T_4	89(70.63)	29.15	17.23	12.03	29.26	0.3767	2604.14	32.93
T_5	87(68.87)	28.36	16.33	11.13	27.46	0.3800	2389.02	33.06
T_6	88(69.73)	27.07	16.46	11.30	27.76	0.3767	2442.88	32.56
Mean	89(71.34)	29.27	17.06	11.96	29.02	0.3786	2601.32	33.36
SEd	0.1952(0.2218)	0.2755	0.1522	0.1255	0.2825	0.0031	1.8524	12.5599
C.D (P = 0.05)	0.4197(0.4769)	0.5923	0.3273	0.2698	0.6074	0.0066	3.9826	27.0037

Fig.1 Seed hardening with 1% $CaCl_2$ be employed the better growth in lab test

Fig.2 Filed View - Mliky Stage

Fig.3 Seed enhancement treatment on resultant seed quality in rice *Cv.* IR 64



In any seed production program, seeds from harvest until next sowing season are prime important to ensure good seed germination and plant stand. The fresh seeds of paddy cv. IR 64 which are given the various seed treatments such as To-Control, T_1-1% $CaCl_2$, T_2-l% KCl, T_3-1% KNO_3, T_4-l% NaCl, T_5-10% Cow dung, T_6-3% Panchakavya of seeds. After harvest fresh seeds are dried back in to safer original moisture content 10 per cent and evaluated the seed quality parameters of resultant seed quality under the laboratory condition. In might be due to the enhanced crop stands, growth and yield that ultimately results in the improvement of seed quality (Vijayan, 2005; Susmitha, 2006; Rehman *et al.*, 2011; Patil *et al.*, 2014; Vijayan and Krishnasamy, 2014; Roohul Amin *et al.*, 2016). Influence of seed enhancement a seed with chemicals and organic hardened materials enhances the seed quality as measured by seed emergence, seedling length, seedling dry weight, seedling fresh weight with all growth and yield attributing characters in drought region and semi drought region, leading to savings on seed to the farmers. Seed hardening with 1% $CaCl_2$ increased in seed quality, growth and yield when compared to control. Therefore, this study concludes that seed enhances with 1% $CaCl_2$ be employed for better crop growth and yield parameters of rice cv. IR 64.

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