Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 94-100

https://doi.org/10.55544/jrasb.2.6.13

Effect of Priming on Seed Germination Characteristics of Spring Rice (*Oryza sativa* cv. Hardinath Hybrid-1) in Chandrapur, Rautahat, NEPAL

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www.jrasb.com || Vol. 2 No. 6 (2023): December Issue

Received: 03-12-2023	**Revised:** 05-12-2023	**Accepted:** 07-12-2023

ABSTRACT

To determine the effects of different priming on Germination and Seedling Characteristics of Spring rice (*Oryza Sativa* L.), an experiment was carried out at Chandrapur municipality-4, Rautahat during March of 2022 with Seven different treatments viz. T1 Potash (3% Solution), T2 Urea (3% Solution), T3 DAP (3% Solution), T4 Halo (1Mole Nacl/Litre), T5 Zinc (3% Solution), T6 Hydro and T7 Control. The experiment was laid out in simple CRD design with three replications. Hardinath Hybrid-1 Variety was used for the experiment. Observations on Germination %, Germination Energy (%), Speed of Germination (%), Vigor Index, Root and Shoot Length, Fresh Weight of Seedlings and Dry Weight of Seedlings were considered. Data was entered and tabulated using MS-Excel, while Analysis of variation and mean separation was done using R-Studio. Biometrical Observation like germination Energy was found highest under the treatment DAP (82.67). The germination percentage (93.00) and vigor index (161.4) was found highest in DAP (3%) Priming and speed of germination (86.84) was found highest in Potash Priming. Similarly, root length (6.14cm) and shoot length (6.23cm) was found to be highest in DAP treatment followed by Halo treatment with root length (5.30cm) and shoot length (5.44 cm). At 10th and 15th Day, there is significant effect on root length while there are no significant differences/effect on Shoot length, fresh weight and Dry Weight. Among these priming treatments, the highest root length was found in priming of DAP; 7.84 cm and 8.07 cm.

Keywords- Spring rice, Priming, Fertilizer treatments.

I. INTRODUCTION

Rice, specifically Oryza sativa L., holds great significance in Asia, where it is produced and consumed as a staple food. It is the world's second most important cereal crop after corn, accounting for nearly 90% of the rice produced and consumed in the region. More than 2 billion people in Asia obtain approximately 60-70% of their calories from rice (Dowling, Greenfield, & Fisher, 1998). Agriculture is the leading sector in the national economy, contributing to about 25.85% of the GDP (MOALD, 2020) . However, the productivity of rice in Nepal remains stagnant at 3.82 tons per hectare, while the global average stands at 4.6 tons per hectare ("World Food and Agriculture – Statistical Yearbook 2022," 2022)

The demand for food is expected to increase as a result of population growth and economic development, requiring an approximate 1% annual increase in world rice production (Horie, Shiraiwa, & Homa, 2004). Rice is Nepal's most significant crop, accounting for roughly half of the country's total cereal

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 94-100
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grain production (Ghimire, Dhungana, Krishna, No, & Sherchan, 2013). Nepal, a mountainous country with diverse rice ecosystems, has many landraces of rice suitable for various agro-climates and farmers' needs (joshi & Pandey, 2006).Rice, an annual, self-pollinated, and semi-aquatic plant of the Poaceae family, is commonly referred to as Dhaan in Nepali.

Given the escalating demand for rice due to the growth in population and the scarcity of land and water resources for rice cultivation, it is of utmost importance to develop and utilize advanced rice technologies that can lead to higher yields .In the last fiscal year, Nepal imported a staggering 1.2 million tonnes of rice worth $402.91 million, which is a significant increase from the 8,025 tonnes imported two decades ago, valued at $1.74 million (Editorial, 2022). Furthermore, during the fiscal year 2076/77 B.S., PMAMP declared Rautahat district as a 'Paddy Seed Zone'.

Rice is a staple food in the Asian region, and it is the primary source of sustenance for the people of Nepal. More than 58 percent of the total cultivated land and 55 percent of the total food grain production in Nepal are attributed to rice. Furthermore, it accounts for over 50 percent of the total calorie requirement of the Nepalese people. Nepal is considered one of the centers of origin of rice, and it is the home of many rice varieties, including Jumli Marshi, which is a cold-tolerant local variety that is grown at high altitudes. In the 2020/21 crop season, rice occupied 1,473,474 ha of land with a production of 5,621,710 metric tons and a productivity of 3.82 metric tons per hectare. Similarly, in Rautahat, 36,998 ha of land was cultivated with rice, producing 1,29,953 metric tons and achieving a productivity of 3.51 metric tons per hectare. Rice is grown in Nepal at altitudes ranging from 60 to 3,050 masl, with 3,050 masl being the highest altitude at which it is grown in the world.

II. MATERIALS AND METHODS

Research was carried out in Chandrapur-4, Rautahat. It was done in CRD Method and details about materials and methods are described in different sub-headings below:

2.1 Research Site and Duration of Research

The experiment was conducted at Chandrapur, Rautahat under the command area of PMAMP, PIU, Rautahat Paddy Seed Zone. The site is located at 27°11'69.81" North latitude and 85°35'69.35" East longitudes with the elevation of 122-244 meters above sea level. The research was carried out from 6th March 2022 to 23rd March 2022.

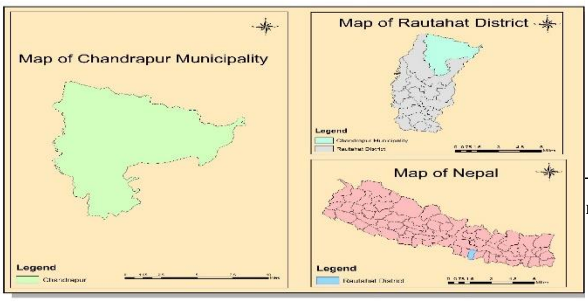

Figure 1 : Map Showing the location of Research Area

2.2 Weather Condition

The research site lies in the subtropical zone of Nepal. During the research period i.e. March it is characterized by mild spring.

2.3Treatment details

Table 1: Treatment Details

S.N.	Treatment	Treatment Details
1	T1	Urea (3% Solution)-30gmUrea/L Water
2	T2	DAP (3% Solution)-30gm DAP/L Water
3	T3	Potash (3% Solution)-30gm Mop/L Water
4	T4	Zinc (3% Solution)-30gm $Znso_4$/L Water
5	T5	Halo (NaCl 1Mole/L Solution)58.5gm Nacl/L Water
6	T6	Hydro solution
7	T7	Control (No Priming)

2.4 Experimental Details

Five Different treatments were prepared maintaining the mentioned concentration using water and specific solutes. Some amount of Seeds (>100) were soaked/primed for 24 hours separately on 6 treatments. Then, the seeds were washed with clean distilled water and air dried.

Then, onward 100 seeds were arranged on squared pattern on each germination Paper for 7 treatments and 3 Replications.

There were altogether 21 Germination Paper used. The germination Paper were moistened using wash bottle/Sprayer time to time. Data was recorded after 24 hour of Placing of Seed on Germination paper. Daily 10 Seeds from each treatments were studied based on parameters. The mean day temperature during my research was 26 °C and mean atmospheric humidity was 55%.

2.5 Variety

- Hardinath-1 Hybrid Variety

2.6 Layout Plan

R1	R2	R3
T1	T3	T2
T2	T4	T5
T6	T1	T6
T3	T7	T7
T5	T6	T4
T4	T2	T1

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T7	T5	T3

Figure 1: Layout Plan

2.7 Parameters Recorded

- Germination (%)

Here, We count the number of seeds germinated from Day 1 to Day 7. In analysis phase, we use the data of 7th day of Sowing Seed on Germination Paper. It is expressed in Percentage.
Germination (%) = (No. of seed germinated/Total no. of seeds for test) X100

- Speed of Germination

Here, We measure the rapidness of germination of seeds. Speed of Germination (%) = (No. of seeds germinated at 72 hr. /No. of seeds germinated at 168 hr.)*100 . It is also expressed in percentage.

- Germination Energy

Germination energy is defined as the percentage by number of seeds in a given sample which germinate within a definite period(Willan,1987).
Germination energy was expressed as percentage of seeds germinated at 72 hr. ((Bam Rk, 2006)

- Vigor Index

It is total sum of all attributes of seeds which indicates the potential level and activity of seed during germination and seedling emergence. Daily count of germination of seed will be taken to calculate data on vigor index. It can be calculated by the following formula (Maguire ID, 1962).

- Vigor index = $X_1/N_1 + X_2/N_2 + \ldots + X_n / N_n$
- Where,
- X_1= number of seedlings at first count
- N_1= number of days at first count
- X_2= number of seedlings at second count
- N_2= number of days at second count
- X_n = number of seedlings at final count
- N_n = number of days at final count

- Shoot length

It the length of seedling above the root part. It is measured using the Normal Measuring Scale. It is expressed in centimeter.

- Root length

It the length of seedling of region that is found below earth surface. It is measured using normal Scale. It is expressed in centimeter.

- Seedling Weight

It is the weight of seedling. It is expressed in gram.

- Seedling dry weight

It is the weight of Seedling that is measured after drying in sun of average 29 °C for 5 hour. It is also expressed in gram.

2.8 Data Analysis Techniques

- Data entry and processing was carried out using Microsoft excel software. Analysis of variance was calculated using R-studio. The hypothesis was tested using f test at 5 percent level of significance and the means were compared using Duncan's Multiple Range Test (DMRT).

III. RESULTS

The experiment was completed within 17 days and various data were recorded and analyzed using different techniques. The analyzed data are presented below on different sub-headings:

3.1 Effect of Seed Priming treatments on Germination Characteristics of Paddy

- All the germination parameters with effect of six priming treatments and control are presented on Table 2. Due to priming treatments, germination energy, germination percentage, speed of germination and vigor index varied widely and all these parameters were affected significantly. Germination Energy was found highest under the treatment DAP-3% (82.67) and lowest under the treatment Urea-3%(62) .The germination percentage (93.00) and vigor index (161.4) was found highest in DAP (3%) Priming and speed of germination (86.84) was found highest in Potash Priming. In the Same Way, germination percentage (80) was found lowest in Halo-1mole/L priming. Speed of Germination(69.67%) and Vigor Index(126.02) was found lowest in Urea-3% Priming.

Table 2: Effect of Seed Priming treatments on Germination Characteristics of Paddy

Treatments (Priming)	Germination Energy (%)	Germination (%)	Speed of Germination (%)	Vigor Index
Potash (3%)	80^{a}	91^{ab}	86.84^{a}	148.64^{b}
Urea (3%)	62^{c}	84^{cd}	69.67^{c}	126.02^{d}
DAP(3%)	82.67^{a}	93^{a}	83.14^{a}	161.45^{a}
Halo(1mole/L)	69^{b}	80^{d}	76.77^{b}	129.90^{cd}
Zinc(3%)	83^{a}	92^{a}	72.10^{c}	145.20^{bc}
Hydro	79.67^{a}	87^{bc}	77.39^{b}	143.02^{bc}
Control	78^{b}	86^{c}	71.36^{c}	135.80^{bcd}
LSD(=0.05)	2.45	4.08	4.28	12.55
Sem(±)	0.81	1.34	1.41	4.14
F Probability	***	***	***	***
CV	1.83	2.66	3.19	5.07

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 94-100
https://doi.org/10.55544/jrasb.2.6.13

Grand Mean	76.33	87.57	76.75	141.43

Note: The common letter(s) within the column indicate non-significant difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance, * significant at 5% level of significance ** significant at 1% level of significance, *** significant at 0.1% level of significance (SEm – Standard Error of mean, CV – Coefficient of Variation, LSD – Least Significance Difference)

3.2 Effect of Seed Priming treatments on Root length of seedlings

There is significant effect of priming treatments on root of Paddy. The treatments shows variation on the length of root. Root length (6.14cm) was found to be highest in DAP treatment followed by Halo treatment with root length (5.30cm) at 7th Day. Similarly, at 10th and 15th Day, DAP's effect on the root is seen as supreme than other treatments. Potash is seen as effective treatment after DAP as compared on each data measured day. At 7th (2.30cm) and 10th (3.69cm) Day, Urea-3% was seen ineffective among other treatments and at 15th day (6.99cm) , Halo-1gm/L was seen ineffective among all.

Table 3: Effect of Seed Priming treatments on Root length of seedlings

Treatments (Priming)	Root Length(cm) 7 DAP	Root Length(cm) 10 DAP	Root Length(cm) 15 DAP
Potash (3%)	5.02^{ab}	7.35^{ab}	7.84^{a}
Urea (3%)	2.30^{c}	3.69^{d}	7.02^{b}
DAP(3%)	6.14^{a}	7.84^{a}	8.07^{a}
Halo(1mole/L)	5.30^{ab}	6.80^{b}	6.99^{b}
Zinc(3%)	4.10^{b}	5.61^{c}	7.06^{b}
Hydro	4.78^{ab}	5.61^{c}	7.55^{ab}
Control	4.21^{b}	5.80^{c}	7.05^{b}
LSD(=0.05)	1.38	0.82	0.54
Sem(±)	0.46	0.27	0.18
F Probability	**	***	**
CV	17.38	7.59	4.22
Grand Mean	4.55	6.14	7.37

Note: The common letter(s) within the column indicate non-significant difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance, * significant at 5% level of significance ** significant at 1% level of significance, *** significant at 0.1% level of significance (SEm – Standard Error of mean, CV – Coefficient of Variation, LSD – Least Significance Difference)

3.3 Effect of Seed Priming treatments on Shoot Length of Seedlings

The effect of treatments on the length of Shoot is seen negligible and is non-significant. Shoot length (6.23cm) was found to be highest in DAP treatment followed by Halo treatment with shoot length (5.44 cm) at 7th day. On 10th and 15th Day, DAP(8.07) and Potash(9.21) are seen as effective and supreme to other treatments respectively.

Table 4: Effect of Seed Priming treatments on Shoot Length of Seedlings

Treatments (Priming)	Shoot Length(cm) 7 DAP	Shoot Length(cm) 10 DAP	Shoot Length(cm) 15 DAP
Potash (3%)	5.03^{ab}	7.03^{ab}	9.21^{a}
Urea (3%)	4.23^{b}	6.43^{b}	8.83^{ab}
DAP(3%)	6.23^{a}	8.07^{a}	8.89^{ab}
Halo(1mole/L)	5.44^{ab}	7.48^{ab}	8.87^{ab}
Zinc(3%)	5.02^{ab}	7.02^{ab}	8.66^{b}
Hydro	4.49^{ab}	6.61^{b}	8.80^{ab}
Control	5.23^{ab}	6.61^{b}	8.79^{ab}
LSD(=0.05)	1.75	1.09	0.38
Sem(±)	0.58	0.36	0.13
F Probability	NS	NS	NS
CV	19.6	8.89	2.46
Grand Mean	5.09	7.03	8.86

Note: The common letter(s) within the column indicate non-significant difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance, * significant at 5% level of significance ** significant at 1% level of significance, *** significant at 0.1% level of significance (SEm – Standard Error of mean, CV – Coefficient of Variation, LSD – Least Significance Difference).

3.4 Effect of Seed Priming treatments on Weight of Seedlings.

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 94-100
https://doi.org/10.55544/jrasb.2.6.13

I cannot find out any markable significant differences on the weight of seedlings before and after drying. There were differences between the weight in small margin but Urea treated seedling has minimum of weight among all.

Table 5: Effect of Seed Priming treatments on Weight of Seedlings.

Treatments (Priming)	Fresh Weight(Mg) 15 DAP	Dry Weight(Mg) 15 DAP
Potash (3%)	0.075	0.012
Urea (3%)	0.071	0.009
DAP(3%)	0.072	0.012
Halo(1mole/L)	0.073	0.013
Zinc(3%)	0.072	0.013
Hydro	0.072	0.013
Control	0.070	0.012
LSD(=0.05)	0.0026	0.0032
Sem(±)	0.0009	0.0011
F Probability	NS	NS
CV	2.10	15.05
Grand Mean	0.072	0.012

Note: The common letter(s) within the column indicate non-significant difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance, * significant at 5% level of significance ** significant at 1% level of significance, *** significant at 0.1% level of significance (SEm – Standard Error of mean, CV – Coefficient of Variation, LSD – Least Significance Difference)

IV. DISCUSSION

Application of pre-sowing seed treatment resulted in maximum germination. Seeds of rice showed maximum germination (93%) when applying DAP priming with Hardinath Hybrid-1 variety. Seed priming is the process of hydrating the seed to initiate the pre-germinating metabolism followed by dehydration which fixes the biochemical events. During priming, a number of physiochemical changes occurs and modifies the protoplasmic character. More absorption of water cause increase inelasticity of cell and development of efficient root system.

Based on Parameters of Table 2

Zinc, DAP, Potash treatment were overall seen effective on priming paddy seeds and Urea should be prohibited to use in priming of Paddy seeds and no significant differences where seen in Shoot Length, Dry weight and Fresh Weight.(Koirala et al., 2019) .

(Prasad & Singh, 2012) reported that hydro-priming for 24 hours enhanced germination percentage than unprimed rice seeds.

Length, Dry weight and Fresh Weight.(Koirala et al., 2019)

Commercial Muriate of Potash fertilizer is the 95:5 mixtures of Pottasium Cholride (KCl) and Sodium Chloride (NaCl). KCl being the major constituent in MOP, it has similar effects as that of KCl in various other studies.In a study conducted by (Islam et al., 2012), priming with 20.74g/l KCl solution enhanced germination than hydropriming.

(Silva & da Silva, 2016) reported that hydro-priming and priming with zinc sulfate had a similar effect on germination percentage in "Puita" cultivar and was superior to control/no priming treatment. These studies are in agreement with the findings of present study.

(Prasad & Singh, 2012) reported that hydro-priming for 24 hours enhanced germination energy and vigor index significantly than unprimed rice seeds. These studies also have similar findings as of our study.

(Farooq et al., n.d.) studied the effect of commercial fertilizers urea, Nitrophos, DAP and SOP as priming agents at 5% concentration in coarse and fine rice. All the treatments resulted in lowering the vigor compared with that of control.

In the recent study, urea priming has lowered the vigor, which is in line with this study but it has a contradiction in an enhancement of vigor by DAP priming which may be due to the difference in concentrations of solutes used.

In a study conducted by (Islam et al., 2012), priming with 20.74g/l KCl solution showed better results than hydropriming for germination energy and vigor index.

In a study by Farooq et al. (2005) complete failure of seed germination was observed in 5% urea priming treatment and 5% DAP priming treatment reduced the germination percentage than control in fine rice which is in contradiction with the findings of our study. This difference could be due to the difference in concentration of solutes.

Based on Parameters of Table 3

Zinc, DAP, Potash treatment were overall seen effective on priming paddy seeds and Urea should be prohibited to use in priming of Paddy seeds and no significant differences where seen in Shoot

(Silva & da Silva, 2016) reported that hydropriming and priming with zinc sulfate enhanced seedling length than control treatment . It has a contradiction in a reduction of seedling length by ZnSO4 priming and hydro in this study which may be due to the difference in concentrations of solutes and variety used.

Based on Parameters of Table 4

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 94-100
https://doi.org/10.55544/jrasb.2.6.13

Zinc, DAP, Potash treatment were overall seen effective on priming paddy seeds and Urea should be prohibited to use in priming of Paddy seeds and no significant differences where seen in Shoot Length, Dry weight and Fresh Weight.(Koirala et al., 2019)

(Silva & da Silva, 2016) reported that hydropriming and priming with zinc sulfate enhanced seedling length than control treatment . It has a contradiction in a reduction of seedling length by ZnSO4 priming and hydro in this study which may be due to the difference in concentrations of solutes and variety used.

Based on Parameters of Table 5

Zinc, DAP, Potash treatment were overall seen effective on priming paddy seeds and Urea should be prohibited to use in priming of Paddy seeds and no significant differences where seen in Shoot Length, Dry weight and Fresh Weight.(Koirala et al., 2019)

According to (Sabita Ghimire et al., 2021) ,There were no significant differences on the fresh weight and dryweight of paddy seedlings after hydropriming and halopriming.

V. SUMMARY AND CONCLUSION

A vital stage of a plant's existence that is extremely sensitive to changes in its surroundings is germination. Using prepared seed can result in uniform, quick, and high-quality seedling germination. When seeds are primed, germination times are shortened, crop uniformity is enhanced upon emergence, and harvesting efficiency is maximized, potentially leading to higher yield potential. In order to determine and suggest the most effective seed treatment technique for strong germination and high-quality seedling production in the rice-growing region, an effort has been made to access and evaluate effective seed priming methods.

In order to address the issue of low seed germination in the Rautahat rice growing area, research was done in the district of Rautahat to determine an effective seed priming strategy that would improve seed germination and produce excellent seedlings. This region's rice farmers continue to use traditional methods of seed priming, or not prime at all. Paddy Hardinath-1 variety was planted in a CRD design with three replications, and seven priming treatments—urea (3 percent), DAP (3 percent), potash (3 percent), halo (1 mole/L) priming, hydro priming, zinc (3 percent), and control—were applied. From March 6 to March 23, 2022, research was conducted. A variety of seed quality parameters, including germination energy, vigor index, shoot and root lengths, dry weight, and fresh weight, were observed.

Following the examination of several factors, DAP was determined to be the best, followed by zinc and potash. Similar statistical results are obtained with other priming procedures.

According to this study, DAP priming worked incredibly well for the spring rice variety Hardinath-1 Hybrid, and seed priming is an efficient technique for producing consistent, high-quality seedlings. This region's rice farmers continue to use traditional methods of seed priming, or not prime at all. Producers in this research area recommended priming seeds with DAP (3 percent) before planting because they were unaware of the advantages and quick and consistent germination this method provides. It is also a fairly simple process that benefits all rice farmers.

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