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# Determination of seed germination and seedling growth of local and exotic rice varieties with different water

**Avinash Sharma, Sheelawati Monlai, VS Devadas, Boppa Linggi, Anchali Yao and Azizul Haque**

**Abstract**
The present studied conducted on seedling growth and germination of rice varieties with different water. The shoot length, root length, germination percentage, seed vigour, root fresh weight, root dry weight, shoot fresh weight, shoot dry weight observed in local rice Sali, Khampti Lahi and exotic rice Thailand Lahi. The observed data was computed with Factorial Completely Randomized Design (FCRD). Significant variations observed in treatments and varieties. The shoot length ranges of Sali 0.85-2.33 cm, Khampti Lahi 1.43-1.68 cm, Thailand Lahi 1.38-1.65 cm; root length ranges of Sali 2.28-2.55 cm, Khampti Lahi 2.15-2.85 cm, Thailand Lahi 1.83-2.53 cm; shoot fresh weight ranges of Sali 0.18-0.22 gm, Khampti Lahi 0.18-0.22 gm and Thailand Lahi 0.17-0.23 gm; shoot dry weight ranges of Sali 0.07-0.11 gm, Khampti Lahi 0.06-0.10 gm and Thailand Lahi 0.07-0.13 gm; root fresh weight ranges Sali 0.61-0.74 gm, Khampti Lahi 0.59-0.71 gm and Thailand Lahi 0.57-0.77 gm; root dry weight ranges of Sali 0.11-0.18 gm, Khampti Lahi 0.10-0.17 gm and Thailand Lahi 0.14-0.33 gm; Germination percentage of ranges of Sali 33.33-71.43%, Khampti Lahi 48.00-84.35% and Thailand Lahi 30.43-80.77% and Seed vigour ranges of Sali 1.42-3.19, Khampti Lahi 1.73-3.66 and Thailand Lahi 1.06-3.24 were obtained with different water. The highest shoot length was obtained with river and slurry water treatments. The highest root length was obtained with treatment $T_5$ Soil water. The highest shoot fresh weight was obtained with $T_7$ slurry water, treatment $T_2$ drinking water and $T_5$ soil water. The highest shoot dry weight was obtained with treatment $T_7$ slurry water, treatment $T_3$ drain water and treatment $T_6$ river water. The highest root fresh weight was obtained with treatment $T_7$ slurry water, treatment $T_5$ soil water and treatment $T_6$ river water. The highest root dry weight was obtained with treatment $T_7$ river water, treatment $T_2$ drinking water and treatment $T_5$ soil water. The highest germination percentage was obtained with treatment $T_2$ drinking water. The highest seed vigour was obtained with treatment $T_6$ river water and treatment $T_2$ drinking water. The availability of nutrient in different water conducts germination and seedling growth of rice varieties. The physiology of seed promotes germination and morphological development.

**Keywords:** Rice, water, germination, seedling growth

## Introduction
Rice is the most prominent cereal crop that caters half of the world population. The global per capita food consumption was 53.7 kg in 2017 and is 53.9 kg in 2018 (FAO, 2018) [3]. The world paddy production was 756.7 million tonnes and 502.2 million tonnes milled rice in 2017. The paddy production of India was 164.2 million tonnes and 109.5 million tonnes milled rice in 2017 (FAO, 2017) [2]. There are 30 species of rice in that *indica*, *japonica* and *javanica* are popular species in the world. The indica rice and the japonica rice are cultivated in the Brahmaputra region. Sali and Khampti Lahi are traditional varieties of Namsai region. Thailand Lahi is exotic rice variety of Namsai region. Sali is short height, oblong grain shape, yellow colour and non-sticky type. Khampti Lahi is tall height, long grain shape, yellow colour and sticky type. Thailand Lahi is tall height, long grain shape, brown colour and non sticky type. Sali, Khampti Lahi and Thailand Lahi are principal crops of Namsai circle region.
The different water like drinking water, distilled water, drain water, lake water, river water, pond water, saline water, alkali water, swampy water, saline water, slurry water, contaminated water and soil water grows well lower plants like bryophytes, pteridophytes and hydrophytes. The water offers variable nutrient content and habitat to the lower and hydrophytic plant for growth and development. It promotes metabolism with lower and hydrophytic plant. It maintains ecosystem with biotic as well as abiotic factors. So, different waters are applying for this demonstration. The aim of the topic to identify viability and vigour of rice seeds, to evaluate seedling growth parameters in different water, to evaluate seed germination, to identify germination potential, to determine physiology of seeds with different water,

to identify the relationship of plant with different water. Istiaq *et al*. (2014) [6] observed germination percentage with different rice varieties. Francesco and Aldo (2000) [4] reported germination behaviour of red rice in field and laboratory conditions. Pirdashti *et al*. (2009) [14] viewed germination percentage, radicle length, plumule length, fresh weight, dry weight of shoot & root with several rice varieties. Nahid *et al*. (2018) [13] observed germination percentage in MR 219 rice variety. Vibhuti *et al*. (2015) [16] reported fresh weight, dry weight and seed vigour in rice varieties. With this background, the following objective taken for experiment i.e.,

1. Evaluation of radicle and plumule length of rice varieties
2. Evaluation of fresh weight, dry weight o seedling of root and shoot of rice varieties
3. Evaluation of germination percentage and seed vigour of rice varieties

## Materials and Methods

The local rice varieties Sali, Khampti Lahi and Exotic rice variety Thailand Lahi were germinated in different water like drinking water, pond water, drain water, contaminated water, soil water, river water and slurry water. The root length, shoot length, germination percentage (%), seed vigour, root fresh weight, root dry weight, shoot fresh weight, shoot dry weight observed with different water. The observation reported in Agriculture Laboratory, Arunachal University of studies, Namsai. The dryness of shoot and root observed in open condition. The dry weight shoot and root observed after 30 days. The germination percentage and seed vigour calculated with following formula i.e.

### Germination percentage (%)

Seed vigour index (VI) = Germination percentage x (Root length + shoot length) / 100 (Kharb *et al*., 1994) [11].

### Data analysis

The data was analyzed with Factorial Completely Randomized Design (FCRD) of 1% correction factor. The data was analyzed from ICAR Wasp 1.0 version.

### i) Evaluation of shoot and root length of rice varieties

The data of shoot length depicted in Table 1 and Fig. 1. Significant variations observed among treatments and varieties. The shoot length ranges of Sali 0.85-2.33 cm, Khampti Lahi 1.43-1.68 cm, Thailand Lahi 1.38-1.65 cm, treatments 1.09-1.35 and variety mean 1.19-1.27 reported in with treatments. Among treatments, the highest shoot length 1.35 cm observed with treatment $T_6$ river water. Among varieties, the highest shoot length 1.27 observed with Sali rice variety. Interaction between variety and treatments, the highest shoot length 2.33 cm in Sali and 1.65 cm in Thailand Lahi obtained with treatment $T_6$ river water. The highest shoot length 1.68 cm observed with treatment $T_7$ slurry water.

The figures of root length of rice showed in Table 2 and Fig. 2. Significant differences observed among treatments and varieties, the value ranges of Sali 2.28-2.55 cm, Khampti Lahi 2.15-2.85 cm, Thailand Lahi 1.83-2.53 cm, treatments 1.47-1.55 and variety mean 1.44-1.56 observed in root length. Among treatments, the highest root length 1.57 observed in Treatment T5 soil water. Among varieties, the highest root length 1.56 observed in Khampti Lahi rice variety. Interaction between treatments and variety, the highest root length 2.55 cm resulted in Sali with treatment $T_5$ Soil water. The highest root length 2.83 cm observed in Khampti Lahi with treatment $T_5$ Soil water. The highest root length 2.53 cm observed in Thailand Lahi with treatment $T_5$ Soil water. The presence of mineral nutrient an water potential promotes germination. Te seed physiology promotes root and shoot elongation and development. Javeed *et al*. (2018) [8] observed germination and seedling growth of 30 rice genotypes. They were resulted root length and shoot length of 30 rice genotypes. Sujay () resulted shoot length and root length of upland rice.

**Table 1:** Shoot length of rice varieties obtained with different water

| Shoot Length (cm) | | | | |
|---|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** | **Treatments** |
| T1- Pond Water | 1.55 (1.24) | 1.63 (1.19) | 1.38 (1.19) | 1.21 |
| T2- Drinking Water | 0.85 (1.25) | 1.43 (1.17) | 1.48 (1.52) | 1.09 |
| T3- Drain Water | 1.75 (1.15) | 1.55 (1.07) | 1.45 (1.25) | 1.23 |
| T4- Contaminated Water | 1.20 (0.92) | 1.50 (1.18) | 1.45 (1.27) | 1.14 |
| T5- Soil Water | 1.73 (1.17) | 1.63 (1.18) | 1.48 (1.50) | 1.25 |
| T6- River Water | 2.33 (1.20) | 1.65 (1.31) | 1.65 (1.25) | 1.35 |
| T7- Slurry Water | 2.25 (1.32) | 1.68 (1.26) | 1.45 (1.16) | 1.31 |
| Mean | 1.27 | 1.22 | 1.19 | |

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **F cal** | **F prob** |
| Replications | 3 | 2.038 | 0.679 | 17.576 | 0.000 |
| Treatments | 20 | 1.307 | 0.065 | 1.691 | 0.061 |
| Factor A | 6 | 0.564 | 0.094 | 2.431 | 0.036 |
| Factor B | 2 | 0.083 | 0.041 | 1.069 | 0.350 |
| A X B | 12 | 0.661 | 0.055 | 1.424 | 0.180 |
| Error | 60 | 2.319 | 0.039 | - | - |
| Total | 83 | - | - | - | - |

Coefficient of Variation = 16.03 CD (1%) = 0.37

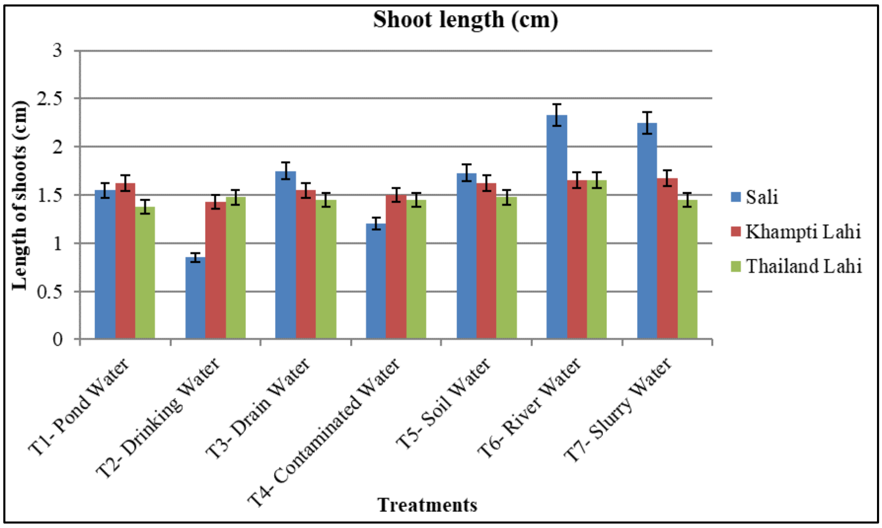


**Fig 1:** Shoot length obtained fom local and exotic rice varieties

**Table 2:** Root length of rice varieties obtained with different water

| Root Length (cm) | | | | |
|---|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** | **Treatments** |
| T1- Pond Water | 2.28 (1.500) | 2.15 (1.510) | 2.13 (1.457) | 1.47 |
| T2- Drinking Water | 2.35 (1.453) | 2.40 (1.461) | 2.53 (1.564) | 1.54 |
| T3- Drain Water | 2.50 (1.444) | 2.35 (1.556) | 2.15 (1.474) | 1.52 |
| T4- Contaminated Water | 2.48 (1.522) | 2.63 (1.608) | 1.83 (1.373) | 1.50 |
| T5- Soil Water | 2.55 (1.524) | 2.83 (1.344) | 2.20 (1.561) | 1.57 |
| T6- River Water | 2.50 (1.583) | 2.23 (1.575) | 1.93 (1.682) | 1.47 |
| T7- Slurry Water | 2.53 (1.574) | 2.85 (1.678) | 2.03 (1.418) | 1.55 |
| **Mean** | 1.55 | 1.56 | 1.44 | |

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **Fcal** | **F prob** |
| Replications | 3 | 0.651 | 0.217 | 4.537 | 0.006 |
| Treatments | 20 | 0.627 | 0.031 | 0.655 | 0.852 |
| Factor A | 6 | 0.118 | 0.020 | 0.411 | 0.869 |
| Factor B | 2 | 0.252 | 0.126 | 2.635 | 0.080 |
| A X B | 12 | 0.257 | 0.021 | 0.448 | 0.937 |
| Error | 60 | 2.868 | 0.048 | - | - |
| Total | 83 | - | - | - | - |

Coefficient of Variation = 14.410
CD (1%) = 0.411

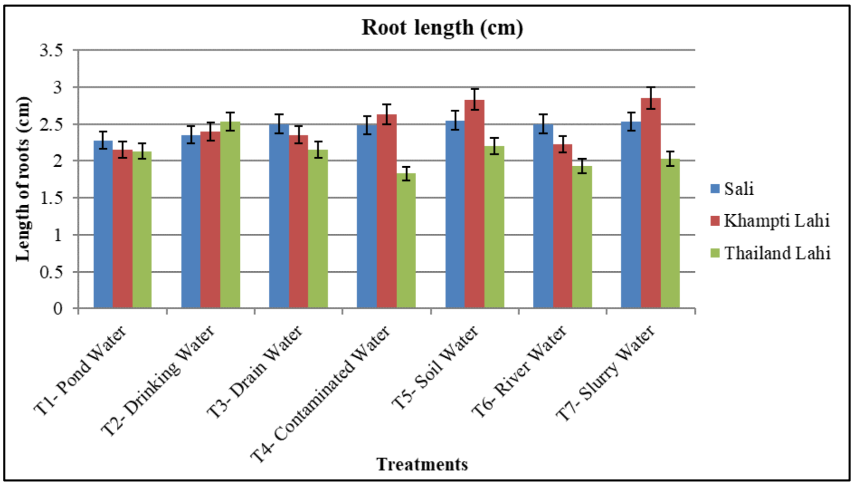


**Fig 2:** Root length obtained from local and exotic rice varieties

**ii) Evaluation of fresh weight, dry weight of shoot and root of rice varieties**

The statistical data of shoot fresh weight and shoot dry weight showed in Table 3 and Fig. 3. Significant variations observed among shoot fresh weight and shoot dry weight. The ranges of Sali 0.18-0.22 gm, Khampti Lahi 0.18-0.22 gm and

Thailand Lahi 0.17-0.23 gm obtained in shoot fresh weight. The value ranges of Sali 0.07-0.11 gm, Khampti Lahi 0.06-0.10 gm and Thailand Lahi 0.07-0.13 gm obtained in shoot dry weight. Interaction between treatments and variety, the highest shoot fresh weight 0.22 gm observed in Sali with treatment $T_7$ slurry water. The highest shoot fresh weight 0.22 gm observed in Khampti Lahi with treatment $T_2$ drinking water. The highest shoot fresh weight 0.23 gm observed in Thailand Lahi with treatment $T_5$ soil water. Among shoot dry weight, the highest shoot dry weight 0.11 gm observed in Sali with treatment $T_7$ slurry water. The highest shoot dry weight 0.10 gm observed in Khampti Lahi with treatment $T_3$ drain water. The highest shoot dry weight 0.13 gm observed in Thailand Lahi with treatment $T_6$ river water. The fresh shoot uptakes nutrient and conducts water movement. The physiology promotes shoot growth and development. The dry shot releases water but it contains biomolecules, alkaloids, secondary metabolites, fibre and nutrients. The dry shoots are advantageous for organic production and soil amelioration. Mondal *et al*. (2011) [12] reported shoot fresh weight and shoot dry weight in rice variety Swarna. Kamyar and Hamdollah (2011) [10] obtained shoot fresh weight and dry weight n rice cultivars.

The data of root fresh weight and root dry weight depicted in Table 4 and Fig. 4. Significant differences reported among root fresh weight and root dry weight. The ranges of Sali 0.61-0.74 gm, Khampti Lahi 0.59-0.71 gm and Thailand Lahi 0.57-0.77 gm obtained in root fresh weight. The ranges of Sali 0.11-0.18 gm, Khampti Lahi 0.10-0.17 gm and Thailand Lahi 0.14-0.33 gm obtained in root dry weight. Interaction between treatments and variety, the highest root fresh weight 0.74 gm observed in Sali with treatment $T_7$ slurry water. The highest root fresh weight 0.71 gm observed in Khampti Lahi with treatment $T_5$ soil water. The highest root fresh weight 0.77 gm observed in Thailand Lahi with treatment $T_6$ river water. Among root dry weight, the highest root dry weight 0.18 gm observed in Sali with treatment $T_7$ river water. The highest root dry weight 0.17 gm observed in Khampti Lahi with treatment $T_2$ drinking water. The highest root dry weight 0.33 gm observed in Thailand Lahi with treatment $T_5$ soil water. The root grows in different water. The root intakes beneficial nutrient from water and promotes germination, The dry root advantageous for measures of soil, soil development and organic production. It mitigates environmental pollution and balances ecosystem. Rambod *et al*. (2016) [15] reported root fresh weight and root dry weight in six rice cultivars. Huy and Iwai (2018) [5] reported root fresh weight and root dry weight in rice.

**Table 3:** Shoot fresh weight of rice varieties observed with different water

| Shoot Fresh Weight (gm) | | | | |
|---|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** | **Treatments** |
| T1- Pond Water | 0.185 (0.827) | 0.18 (0.847) | 0.19 (0.856) | 0.828 |
| T2- Drinking Water | 0.2075 (0.826) | 0.22 (0.834) | 0.1725 (0.801) | 0.834 |
| T3- Drain Water | 0.22 (0.831) | 0.2175 (0.838) | 0.195 (0.851) | 0.843 |
| T4- Contaminated Water | 0.195 (0.841) | 0.185(0.814) | 0.22 (0.854) | 0.833 |
| T5- Soil Water | 0.20 (0.841) | 0.195 (0.848) | 0.23325 (0.848) | 0.842 |
| T6- River Water | 0.20 (0.820) | 0.225 (0.836) | 0.23 (0.842) | 0.836 |
| T7- Slurry Water | 0.22 (0.848) | 0.21 (0.834) | 0.2175 (0.847) | 0.846 |
| **Mean** | 0.834 | 0.836 | 0.841 | |

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **F cal** | **F prob** |
| Replications | 3 | 0.001 | 0.000 | 0.867 | 0.464 |
| Treatments | 20 | 0.016 | 0.001 | 1.501 | 0.115 |
| Factor A | 6 | 0.003 | 0.000 | 0.920 | 0.487 |
| Factor B | 2 | 0.001 | 0.000 | 0.692 | 0.505 |
| A X B | 12 | 0.012 | 0.001 | 1.926 | 0.049 |
| Error | 60 | 0.031 | 0.001 | - | - |
| Total | 83 | - | - | - | - |

Coefficient of Variation = 2.726 CD (1%) = 0.043

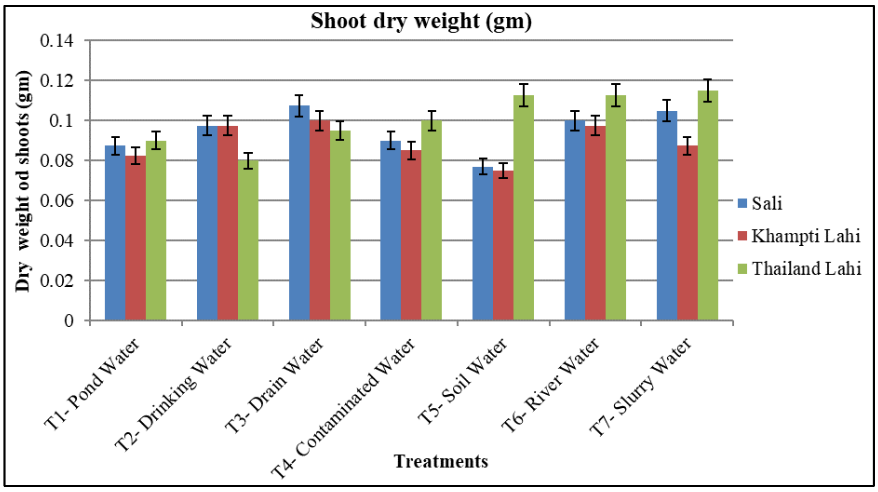


**Fig 3:** Shoot dry weight obtained from local and exotic rice varieties

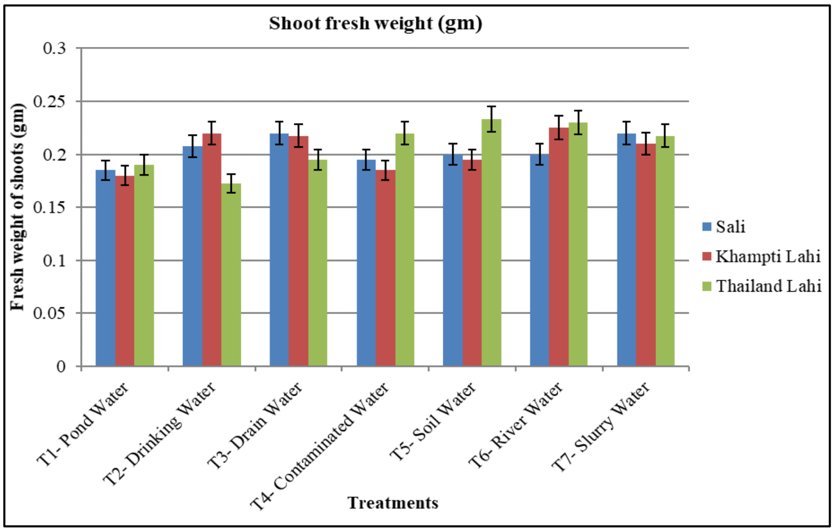


**Fig 4:** Shoot fresh weight obtained from local and exotic rice varieties

**Table 4:** Shoot dry weight of rice varieties observed with different water

| Shoot Dry Weight (gm) | | | | |
|---|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** | **Treatments** |
| T1- Pond Water | 0.0875 (0.295) | 0.0825 (0.315) | 0.09 (0.335) | 0.291 |
| T2- Drinking Water | 0.0975 (0.278) | 0.0975 (0.308) | 0.08 (0.314) | 0.304 |
| T3- Drain Water | 0.1075 (0.299) | 0.10 (0.299) | 0.095(0.310) | 0.317 |
| T4- Contaminated Water | 0.09 (0.311) | 0.085 (0.290) | 0.10 (0.335) | 0.301 |
| T5- Soil Water | 0.077 (0.311) | 0.075 (0.314) | 0.1125 (0.323) | 0.305 |
| T6- River Water | 0.1 (0.291) | 0.0975 (0.307) | 0.1125 (0.292) | 0.320 |
| T7- Slurry Water | 0.105 (0.327) | 0.0875 (0.272) | 0.115 (0.339) | 0.318 |
| Mean | 0.311 | 0.296 | 0.317 | |

Coefficient of Variation = 9.483 CD (1%) = 0.055

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **F cal** | **F prob** |
| Replications | 3 | 0.004 | 0.001 | 1.408 | 0.249 |
| Treatments | 20 | 0.026 | 0.001 | 1.523 | 0.107 |
| Factor A | 6 | 0.008 | 0.001 | 1.595 | 0.164 |
| Factor B | 2 | 0.007 | 0.003 | 4.096 | 0.021 |
| A X B | 12 | 0.011 | 0.001 | 1.058 | 0.411 |
| Error | 60 | 0.051 | 0.001 | - | - |
| Total | 83 | - | - | - | - |

**Table 5:** Root fresh weight of rice varieties obtained with different water

| Root Fresh Weight (gm) | | | | |
|---|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** | **Treatments** |
| T1- Pond Water | 0.70 (0.832) | 0.68 (0.764) | 0.685 (0.843) | 0.826 |
| T2- Drinking Water | 0.65 (0.824) | 0.675 (0.745) | 0.7175 (0.860) | 0.820 |
| T3- Drain Water | 0.61 (0.821) | 0.585 (0.799) | 0.57 (0.838) | 0.763 |
| T4- Contaminated Water | 0.65 (0.798) | 0.635 (0.796) | 0.665 (0.878) | 0.801 |
| T5- Soil Water | 0.72 (0.819) | 0.7075 (0.808) | 0.7175 (0.859) | 0.843 |
| T6- River Water | 0.68 (0.843) | 0.705 (0.846) | 0.7725 (0.830) | 0.859 |
| T7- Slurry Water | 0.74 (0.780) | 0.69 (0.841) | 0.725 (0.850) | 0.846 |
| Mean | 0.825 | 0.816 | 0.827 | |

Coefficient of Variation = 9.015
CD (1%) = 0.139

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **F cal** | **F prob** |
| Replications | 3 | 0.044 | 0.015 | 2.676 | 0.055 |
| Treatments | 20 | 0.088 | 0.004 | 0.800 | 0.703 |
| Factor A | 6 | 0.076 | 0.013 | 2.300 | 0.046 |
| Factor B | 2 | 0.002 | 0.001 | 0.178 | 0.837 |
| A X B | 12 | 0.010 | 0.001 | 0.154 | 0.999 |
| Error | 60 | 0.330 | 0.006 | - | - |
| Total | 83 | - | - | - | - |

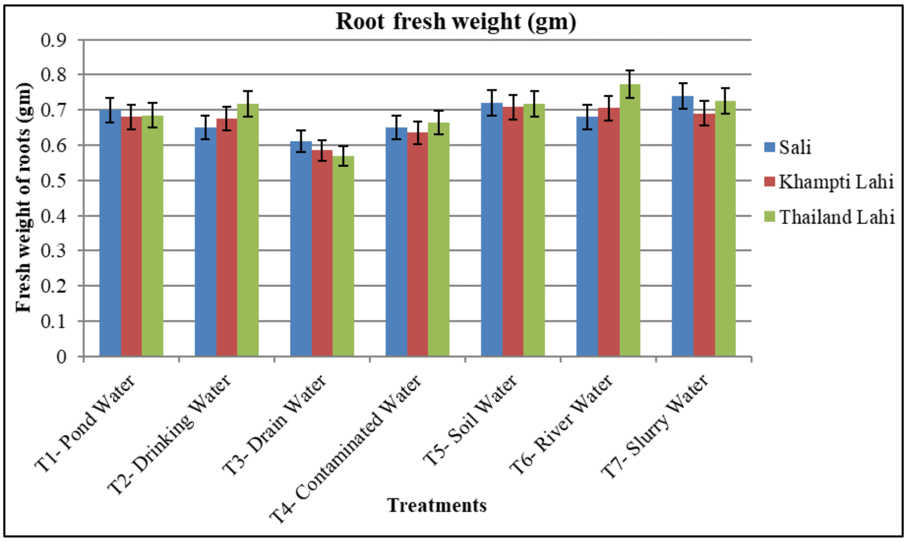


**Fig 5:** Root fresh weight obtained from local and exotic rice varieties

**Table 6:** Root dry weight of rice varieties observed with different water Coefficient of Variation = 25.927

| Root Dry Weight (gm) | | | | |
|---|---|---|---|---|
| Varieties Treatments | Sali | Khampti Lahi | Thailand Lahi | Treatments |
| T1- Pond Water | 0.15 (0.388) | 0.15 (0.391) | 0.15 (0.520) | 0.390 |
| T2- Drinking Water | 0.14 (0.394) | 0.17 (0.403) | 0.14 (0.418) | 0.388 |
| T3- Drain Water | 0.15 (0.389) | 0.14 (0.373) | 0.16 (0.393) | 0.394 |
| T4- Contaminated Water | 0.14 (0.382) | 0.11 (0.412) | 0.28 (0.513) | 0.427 |
| T5- Soil Water | 0.14 (0.408) | 0.13 (0.497) | 0.33 (0.405) | 0.438 |
| T6- River Water | 0.18 (0.374) | 0.14 (0.382) | 0.31 (0.395) | 0.441 |
| T7- Slurry Water | 0.17 (0.388) | 0.11 (0.413) | 0.27 (0.495) | 0.432 |
| Mean | 0.391 | 0.401 | 0.456 | |

CD (1%) = 0.203

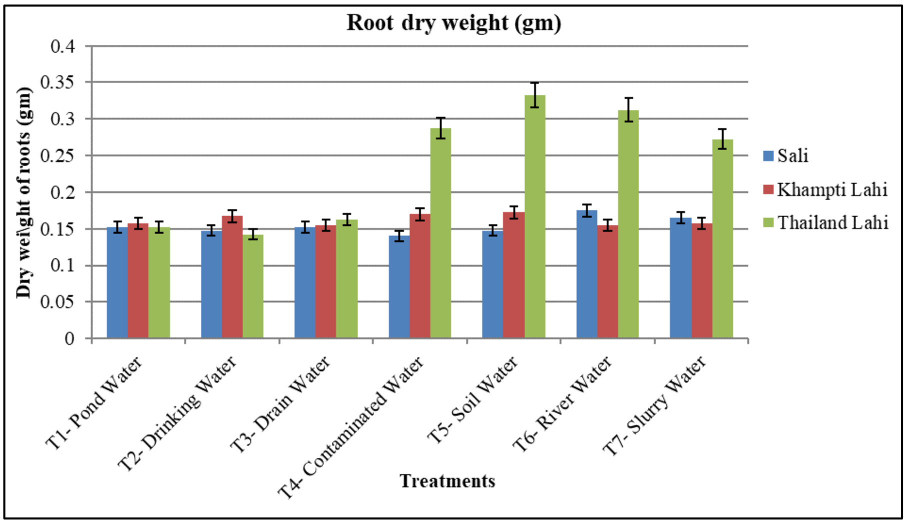


**Fig 6:** Root dry weight obtained from local and exotic rice varieties

**iii) Evaluation of germination percentage and seed vigour of rice varieties**

The data of germination percentage showed in Table 5 and Fig. 5. Significant differences observed among treatments and varieties. The germination percentage ranges of Sali 33.33-71.43%, Khampti Lahi 48.00-84.35% and Thailand Lahi 30.43-80.77%. Interaction between treatments and variety, the highest germination percentage observed in 71.43% Sali, 84.35% Khampti Lahi and 80.77% Thailand Lahi with treatment $T_2$ drinking water. The availability of beneficial elements is more in drinking water that promotes healthy germination of rice varieties. The beneficial element of drinking water conducts physiology in seed and promotes early germination of seeds. The viability of the seed is nutritious in drinking water. Bhawana *et al.* (2018) [1] resulted germination percentage in aromatic rice accession. Islam *et al.* (2000) [7] reported seed germination under different conditions.

The data of seed vigour showed in Table 6 and Fig. 6. Significant variations observed among treatments and varieties. The seed vigour ranges of Sali 1.42-3.19, Khampti Lahi 1.73-3.66 and Thailand Lahi 1.06-3.24. Interaction between treatments and variety, the highest seed vigour observed in 3.19 Sali with treatment $T_6$ river water, 3.66

Khampti Lahi with treatment $T_2$ drinking water and 3.24 Thailand Lahi with treatment $T_2$ drinking water. The early germination of seed shows the viability of seed and active metabolism of seed. Jung-sun *et al*. (2018) studied seed vigour test in rice.

**Table 7:** Germination percentage of rice varieties with different water

| Germination Percentage (%) | | | |
|---|---|---|---|
| **Varieties Treatments** | **Sali** | **Khampti Lahi** | **Thailand Lahi** |
| T1- Pond Water | 57.14 | 67.86 | 54.84 |
| T2- Drinking Water | 71.43 | 84.35 | 80.77 |
| T3- Drain Water | 33.33 | 44.44 | 66.66 |
| T4- Contaminated Water | 60.00 | 76.92 | 50.00 |
| T5- Soil Water | 65.00 | 80.00 | 60.71 |
| T6- River Water | 66.00 | 61.90 | 57.14 |
| T7- Slurry Water | 40.00 | 48.00 | 30.43 |

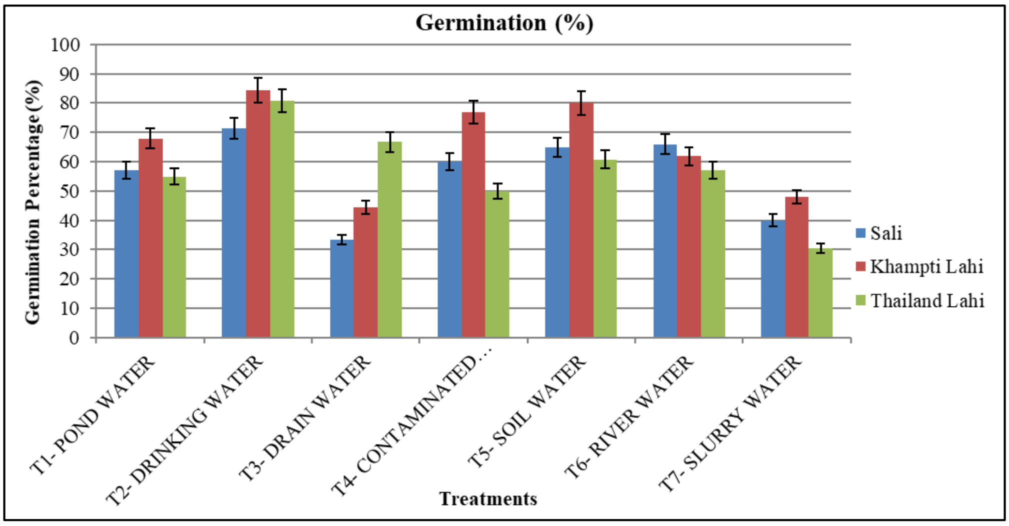


**Fig 7:** Germination percentage obtained from local and exotic rice varieties

**Table 8:** Seed vigour of rice varieties with different water

| Anova Table | | | | | |
|---|---|---|---|---|---|
| **Source of variation** | **Degrees of freedom** | **Sum of squares** | **Mean sum of squares** | **F cal** | **F prob** |
| Replications | 3 | 0.112 | 0.037 | 3.198 | 0.030 |
| Treatments | 20 | 0.175 | 0.009 | 0.753 | 0.755 |
| Factor A | 6 | 0.041 | 0.007 | 0.592 | 0.735 |
| Factor B | 2 | 0.068 | 0.034 | 2.943 | 0.060 |
| A X B | 12 | 0.065 | 0.005 | 0.469 | 0.925 |
| Error | 60 | 0.697 | 0.012 | - | - |
| Total | 83 | - | - | - | - |

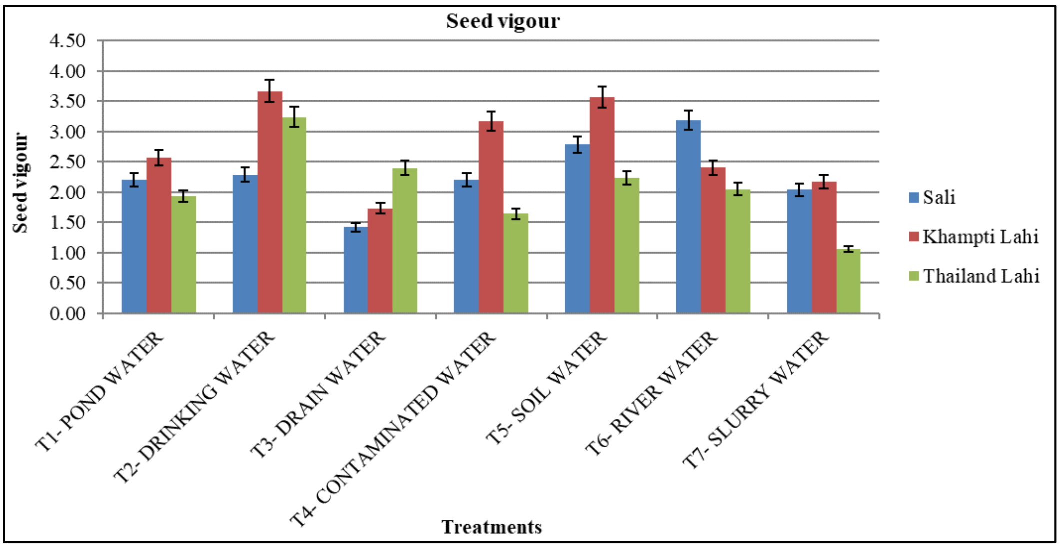


**Fig 8:** Seed vigour obtained from local and exotic rice varieties

**Fig 9:** Seed germination of local and exotic rice varieties in different water

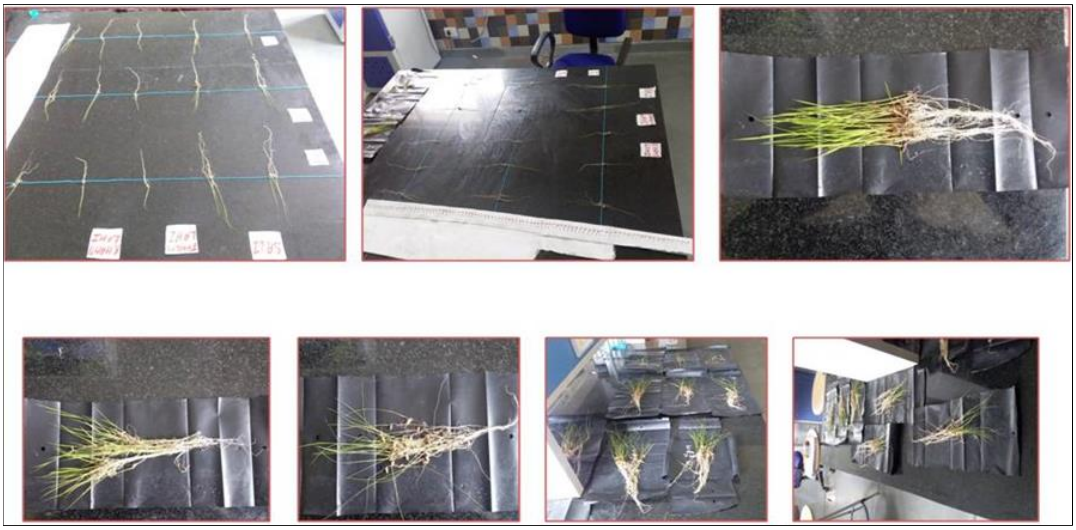

**Fig 10:** Shoot length, root length, shoot dry weight and root dry weight obtained in local and exotic rice varieties

## Conclusion

The rice varieties germinated in the different water. The beneficial nutrients are available in the water. The water conducted metabolism in the seeds. The seed physiology-initiated germination of root and shoot. The fresh matters are available in root and shoot. This matter is useful in anatomical and morphological development. The dry matter of shoot and root are useful in organic production, soil amendments, maintainance biogeochemical cycle and ecosystem. This experiment is useful when there will be a scarcity of water on the earth.

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