

# Physiological behaviour of few Cultivars of Paddy (*Oryza sativa* L.) during Seed Germination and early Growth, subjecting to distillery Effluent Stress

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#### Abstract

An attempt was made to understand physiological behavior of few cultivars of paddy (Oryza sativa L.) subjecting to distillery effluent stress. Physio-chemical data of effluent reveals that it is rich in both organic and inorganic load. Subjecting five cultivars of paddy viz., Jaya, Jyothi, Mandya Vijay and MTU-1001, to different dilution of effluent (viz. 6%, 12%, 25%, 50% and 100%) preliminary germination was conducted. Percent germination, root length and shoot length was almost similar in control and 6% dilution of distillery effluent, with further increase in concentration, gradual inhibitory effect was noticed, whereas complete inhibition was observed at 100%. Physiological parameters such as total carbohydrate, total starch content was high, whereas reducing sugar was low in germinated seedlings treated at higher concentration of effluent. Total protein decreased at higher concentration in all cultivars of paddy. It was high at 6% and decreased gradually with increase in dilution concentration of effluent, when compared to control. These results reveal that degradation and mobilization of seed serves is impaired by cat ions and anions in the effluent by disturbing the activities of enzymes essential for it. Overall data of physiological parameter reveals that Jaya cultivar is sensitive among five cultivars of paddy, when subjected to distillery effluent stress.

Keywords: Distillery effluent, Paddy cultivars, germination, total carbohydrate, total protein, total starch, reducing sugar.

# Introduction

Paddy (*Oryza sativa* L.) is an important cereal crop in India. The crop serves as a staple food in most regions of the world. It constitutes about 53% of the total grain production and 55% of the total of total cereal production<sup>1</sup>. The utilization of industrial effluent for irrigation of crop plant is one of the highly beneficial propositions of waste disposal. There may be two aspects of the use of effluent (Distillery) in agricultural, one is fertilizer value and the other is as a substitute for irrigation water. Distillery factory is one among major water consuming factory and play an important role in creating water pollution problems of considerable magnitude by spent wash<sup>2</sup>.

The Gemini Distilleries Pvt. Limited, working since 1984 is one of the oldest distilleries in Mysore district, located at Nanjanagud industrial area. The industry produces 30 kilolitres of ethyl alcohol per day and also produces 12-15 litres of spent wash per litre of ethyl alcohol, amounting to 45000 litres of effluent per day. Continuous discharge of distillery effluent to paddy field has made the land uncultivable and decline in the yield. Toxicity is a complex biological phenomenon, only biological tests can fully distinguish between what is or is not harmful for living organism. Studies on physiological and biochemical investigation are of great importance in understanding various metabolic processes of plant system. Pollen fertility and germinations are varied with different media

invitro<sup>3</sup>. Heavy metals from industrial effluent may also impact Hence present investigation aims to assess physiological behaviour of few cultivars varieties of paddy during seed germination and early growth, subjecting to abiotic (Distillery effluent) stress.

## **Material and Methods**

The seed samples of certified varieties of paddy viz., Jaya, Jyothi, Mangala, Mandya Vijaya and MTU 1001 were procured from Regional Institute of Agricultural University, V.C. Farm, Mandya, Karnataka. The effluent sample was collected at the point of discharge, in plastic container from Gemini Distillery, Nanjangud. The effluent sample was brought to the laboratory for the analysis of physicochemical parameters. The effluent samples were stored at 4<sup>o</sup>C before chemical analysis was done, for every three days. The collected effluent was analyzed for the physio-chemical parameters by adapting standard procedures from the American Public Health Association<sup>4,5</sup>. The effluent was then used for the experimental purpose.

The certified seeds of paddy cultivars were surface sterilized with 2% sodium hypochloride for 5 min. and rinsed with distilled water for 10-12 times to remove excess of chloride. Five hundred comparably sized paddy seeds were selected and arranged at equal distance on germination sheets – between paper method, with thee replicates supplemented with different

dilution of distillery effluent viz., 6, 12, 25, 50 and 100% along with control, at room temperature  $28 \pm 2^{\circ}$  C in dark<sup>6</sup>. The germination percent, root length and shoot length were recorded as per ISTA standard. The biochemical experiments were conducted for total starch<sup>7</sup>, total carbohydrate<sup>8</sup>, total protein<sup>9</sup>, and reducing sugar<sup>10</sup>, analysis from 7<sup>th</sup>, 10<sup>th</sup> and 14<sup>th</sup> day old seedling and estimated according to standard protocol. The obtained data were subjected to analysis of variance and the means were compared with Tukey's studentized range tests, using SPSS 10.1 version package<sup>11</sup>.

## **Results and Discussion**

The physio-chemical analysis of distillery effluent is presented in table-1. pH of the distillery effluent is acidic in nature and it contains high amount of calcium (3000mg/L), chlorides (8500mg/L), sulphates (6745mg/L), nitrogen (1579mg/L), and potassium (14800mg/L). The effluent is also rich in BOD and COD. The physico-chemical analysis data of distillery effluent clearly shows that it is very rich in organic and inorganic load. To minimize the deleterious effects before the waste is discharged to land, further treatment is necessary to reduce the load. This is in accordance with the findings on different distillery effluents<sup>12-16</sup>.

 Table-1

 Characteristics of raw and treated spent wash

SI			Raw	Treated	
No.	Parameters	Units	Spent	Spent	
190.			wash	wash	
1	pH	-	3.5 - 4.5	7.1 - 7.9	
n	Color		Dark	Faint	
Z	Coloi	-	brown	brown	
3	Temp.	Degree C	35-38	30-32	
4	BOD	mg/lt.	63040	5000	
5	COD	mg/lt.	128900	35000	
6	Total solids	mg/lt.	167400	145500	
7	Suspended solids	mg/lt.	13900	23900	
8	Total dissolved solids	mg/lt.	153500	121600	
9	Sulphate as SO <sub>4</sub>	mg/lt.	6745	6745	
10	Chlorides	mg/lt.	8500	8500	
11	Sodium	mg/lt.	400	400	
12	Potassium	mg/lt.	14800	14800	
13	Magnesium	mg/lt.	1600	1600	
14	Calcium	mg/lt.	3000	3000	
15	Nitrogen as Nitrite	mg/lt.	1579	1579	
16	Phosphorus	mg/lt.	244	244	

The preliminary germination studies were conducted, where the seed germination and early seedling growth affected due to water pollution stress (table- 2). Hence, further investigations on some biochemical changes at seedling stage under distillery effluent stress were conducted.

Enzymes are activated, synthesized and stored, insoluble foods degraded, soluble foods translocated, nutrients mobilized and synthetic reaction related to growth takes place are some of the events takes place during germination. And also, the metabolism increases rapidly and the substrate for this is derived from the storage reserves. The hydrolytic enzymes, particularly  $\alpha$ amylase, proteases, ribonuclease, acid phosphatase and many other enzymes are under the control of gibberllin (GA). During inhibition of the seed, synthesis of polyribosome, endoplasmic reticulum and proteins, followed latter by hydrolytic enzymes were induced by the supply of the hormone GA-3 from the embryo to the aleurone. If any one of these events or even more is affected, that would consequently affect the other events and eventually hinders the germination of the seeds <sup>17, 18, 19</sup>. Probably cations and anions of effluents inhibit enzymes necessary of degradation and mobilization of seed reserve, which are essential of growth and development.

During seed germination the seed reserve – carbohydrate i.e. principally the starch are degraded to provide sugars by amylolytic or phosphorolytic pathways<sup>20</sup>. Total carbohydrates responded significantly (F= 2581.543; P< .000) to the treatment of effluents. It was significant high at 6% treatment and a gradual decrease towards higher concentrations, when compared to control in all paddy cultivars (table-3). Increase in carbohydrate content at lower concentrations<sup>21-23</sup> was mainly due to the availability of more nutrients in the effluent or due to innate tendency to accumulate inorganic nutrients in organic form<sup>24</sup>.

The effect of the treatment of effluent concentration on the quantity of starch (F= 1271.785; P< .000), showed a gradual decrease from 6% to 50% treatment in comparison to control, in all five cultivars of paddy (Table-4). Some workers observed lower starch content at higher effluent concentration<sup>25-27</sup>.

The amount of reducing sugars was least in the 7<sup>th</sup> day seedling and the quantity significantly increases in 14<sup>th</sup> day seedling (table-5). No significant effect on reducing sugar content in *Zea mays* grown in solid and distillery effluent supplement with different concentrations of nitrogen<sup>14</sup>.

The common trend was true in case of total protein also, that higher the concentration greater the impact. The concentration of protein between treatments was found to be significant (F= 347.595; P< .000, table-6). Decrease in the protein content at higher concentrations has been reported<sup>28-31</sup>. These results reveal that degradation and mobilization of seed serves is impaired by cations and anions in the effluent by disturbing the activities of enzymes essential for it.

Cultivar	Concentration	Germn	R Length	S Length
	Control	99.25±0.96	23.43±0.56	16.40±0.50
	6%	89.00±2.58	19.58±0.51	$14.65 \pm 0.39$
т	12%	81.25±2.22	14.08±0.60	12.47±0.65
Jaya	25%	70.00±2.83	4.40±0.36	3.70±0.36
	50%	42.75±4.57	1.43±0.33	2.20±0.94
	Overall	76.45±20.05	12.58±8.72	9.88±5.99
	Control	99.25±1.50	22.83±0.97	16.08±0.75
	6%	85.75±5.32	17.60±0.63	14.45±0.19
Troth::	12%	76.00±4.32	15.35±0.83	13.50±0.56
Jyothii	25%	67.75±5.80	9.23±0.59	$10.10 \pm 1.07$
	50%	41.50±4.93	0.93±0.21	2.93±0.49
	Overall	74.05±20.29	13.19±7.74	11.41±4.83
	Control	$100.00 \pm 0.00$	22.90±0.90	15.73±0.89
	6%	88.50±3.32	17.58±0.56	14.10±0.61
Mangala	12%	80.50±2.52	15.15±0.40	13.48±0.57
Mangala	25%	70.75±1.50	9.30±0.34	10.78±0.61
	50%	41.25±2.99	0.90±0.22	3.73±0.59
	Overall	76.20±20.56	13.17±7.74	11.56±4.38
	Control	99.25±0.96	21.60±0.70	18.00±0.61
	6%	88.75±1.71	15.53±0.56	16.43±1.26
Mandya vijava	12%	73.25±2.99	11.25±0.66	13.63±0.79
Manuya vijaya	25%	55.00±4.76	8.03±0.72	8.78±0.60
	50%	41.50±6.95	$1.50\pm0.37$	3.38±0.83
	Overall	71.55±22.03	11.58±6.98	12.04±5.54
	Control	$100.00 \pm 0.00$	21.55±0.62	$17.10 \pm 1.41$
	6%	90.75±2.22	18.50±0.57	17.63±0.48
MTI 1001	12%	77.75±1.71	12.63±0.75	12.40±0.51
	25%	66.00±6.06	5.30±0.42	8.68±0.61
	50%	45.75±2.06	$1.58 \pm 0.46$	$3.85 \pm 0.80$
	Overall	76.05±19.73	11.91±7.80	11.93±5.39
	Control	99.55±0.89 <sup>e</sup>	22.46±1.03 <sup>e</sup>	$16.66 \pm 1.15^{\circ}$
	6%	88.55±3.35 <sup>d</sup>	$17.76 \pm 1.46^{d}$	$15.45 \pm 1.52^{d}$
Overall	12%	77.75±3.96°	$13.69 \pm 1.70^{\circ}$	$13.09 \pm 0.78^{\circ}$
	25%	65.90±7.11 <sup>b</sup>	7.25±2.13 <sup>b</sup>	8.41±2.62 <sup>b</sup>
	50%	42.55±4.45 <sup>a</sup>	1.27±0.42 <sup>a</sup>	3.22±0.91 <sup>a</sup>
F	-Value	7.008	30.744	27.954

Table-2
Germination percentage (Germn); Root length (R Length); Shoot length (S Length); of five paddy cultivars with different
dilution of distillery effluent

Note: Overall means followed by the same letter within a column are not significantly when subjected to Tukey's mean range test (P<0.05).

# Conclusion

According to our observation we may conclude that industrial effluents are rich in organic and inorganic materials and some toxic substances, which may cause impairment in ionic mobilization and variation in the enzymatic activity. Jaya cultivar is sensitive among five cultivars of paddy, when subjected to stress of distillery effluent.

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Table-3
Total Carbohydrate content of five paddy cultivars with different dilutions of distillery effluent at different time intervals of
germinating seedlings

germinating seedings							
Concentration	Duration	Jaya	Jyothi	Mangala	Mandya vijaya	MTU 1001	Overall
	7 <sup>th</sup> Day	29.33±1.15	36.67±3.06	50.33±3.51	43.00±7.00	49.33±9.012	41.73±9.43
Control	10 <sup>th</sup> Day	45.33±4.04	46.67±4.16	55.33±2.52	54.67±6.66	59.00±9.00	52.20±7.32
Control	14 <sup>th</sup> Day	60.33±5.51	60.67±7.02	66.00±5.20	64.67±7.23	69.50±3.54	63.85±6.06
	Overall	45.00±13.87	48.00±11.31	57.22±7.71	54.11±11.16	58.00±10.89	52.34±11.83 <sup>a</sup>
	7 <sup>th</sup> Day	38.33±2.52	47.33±3.51	52.67±2.52	57.00±6.56	60.33±7.77	51.13±9.09
(0)	10 <sup>th</sup> Day	50.00±8.89	58.00±2.00	64.00±4.00	65.00±6.25	71.00±5.29	61.60±8.83
0%	14 <sup>th</sup> Day	67.67±3.06	70.33±2.08	74.33±6.03	64.00±16.46	67.33±20.817	68.73±10.98
	Overall	52.00±13.68	58.56±10.22	63.67±10.14	62.00±10.12	66.22±12.35	60.49±11.95 <sup>b</sup>
	7 <sup>th</sup> Day	50.67±2.08	56.00±2.65	66.33±1.53	64.00±10.44	68.33±8.50	61.07±8.70
1207	10 <sup>th</sup> Day	62.33±3.79	64.00±3.00	76.33±3.21	77.67±10.97	74.33±5.51	70.93±8.42
12%	14 <sup>th</sup> Day	76.33±5.69	79.00±9.00	89.33±2.08	74.67±18.82	67.33±16.92	77.33±12.77
	Overall	63.11±11.69	66.33±11.25	77.33±10.20	72.11±13.59	70.00±10.39	69.78±12.01 <sup>c</sup>
	7 <sup>th</sup> Day	60.00±2.00	67.00±6.08	72.67±3.51	74.33±11.93	76.67±9.87	70.13±8.96
2507	10 <sup>th</sup> Day	74.33±3.79	78.33±3.06	88.00±6.25	91.33±6.11	88.67±8.08	84.13±8.37
25 %	14 <sup>th</sup> Day	91.67±10.21	97.33±10.07	102.67±2.52	87.67±23.63	82.67±18.58	92.40±14.57
	Overall	75.33±14.81	80.89±14.60	87.78±13.53	84.44±15.64	82.67±12.41	82.22±14.21 <sup>d</sup>
	7 <sup>th</sup> Day	61.00±3.61	66.33±6.11	78.33±2.52	74.67±7.02	77.00±8.54	71.47±8.58
50.0%	10 <sup>th</sup> Day	77.33±2.08	81.67±1.53	93.33±4.51	87.67±10.02	92.00±8.00	86.40±8.19
50%	14 <sup>th</sup> Day	101.67±7.37	97.67±3.06	114.67±5.03	93.67±16.26	96.33±19.86	100.80±12.86
	Overall	80.00±18.22	81.89±14.01	95.44±16.22	85.33±13.20	88.44±14.49	86.22±15.62 <sup>d</sup>
	7 <sup>th</sup> Day	47.87±12.94	54.67±12.56	64.07±11.60	62.60±14.36	66.33±13.14	
Overall	10 <sup>th</sup> Day	61.87±13.85	65.73±13.63	75.40±15.18	75.27±15.87	77.00±13.94	
Overall	14 <sup>th</sup> Day	79.53±16.76	81.00±16.30	89.40±18.83	76.93±19.19	77.14±19.26	
	Overall	63.09±19.37 <sup>a</sup>	67.13±17.69 <sup>ab</sup>	76.29±18.41 <sup>c</sup>	71.60±17.46 <sup>bc</sup>	73.41±16.07 <sup>c</sup>	

**Note:** F=;50.667; P<0.005 Variance between cultivar, F=278.851; P<0.005 Variance between concentration, 2-way interaction, F=2.933; P<0.005.Variance between different concentration and cultivars. Overall means followed by the same letter within a columns and rows of overall are not significantly different when subjected to Tukey's mean range test (P<0.05).

Table-4

Starch content of five paddy cultivars with different dilutions of distillery effluent at different time intervals of germinating seedlings								
Concentration	Duration	Jaya	Jyothi	Mangala	Mandya vijaya	MTU 1001	Overall	
	7 <sup>th</sup> Day	15.67±1.53	16.33±3.21	20.67±4.16	20.00±1.00	19.67±3.06	18.47±3.20	
Control	10 <sup>th</sup> Day	21.33±5.86	23.33±6.11	20.33±3.51	22.67±2.52	19.67±1.53	21.47±3.91	
Control	14 <sup>th</sup> Day	21.67±1.53	26.00±3.61	27.33±3.79	25.00±1.00	26.00±3.00	25.20±3.10	
	Overall	19.56±4.28	21.89±5.82	22.78±4.76	22.56±2.60	21.78±3.90	21.71±4.35 <sup>a</sup>	
	7 <sup>th</sup> Day	15.00±1.00	18.00±1.00	24.33±4.04	28.00±2.65	20.33±1.53	21.13±5.15	
(0)	10 <sup>th</sup> Day	24.00±2.00	27.67±2.52	27.33±2.89	27.00±2.65	25.67±2.08	26.33±2.50	
0%	14 <sup>th</sup> Day	27.33±2.52	28.67±3.51	31.00±3.00	29.33±1.53	31.33±1.53	29.53±2.64	
	Overall	22.11±5.78	24.78±5.56	27.56±4.10	28.11±2.26	25.78±4.99	25.67±4.99 <sup>b</sup>	
	7 <sup>th</sup> Day	19.00±1.00	21.67±1.53	27.00±3.00	27.00±2.00	25.67±1.53	24.07±3.69	
1007	10 <sup>th</sup> Day	29.67±2.08	28.00±2.65	31.00±1.73	32.00±2.00	28.33±2.52	29.80±2.45	
12%	14 <sup>th</sup> Day	32.00±2.00	34.33±3.21	35.00±0.00	37.00±2.00	32.67±4.16	34.20±2.91	
	Overall	26.89±6.19	28.00±5.92	31.00±3.87	32.00±4.66	28.89±3.98	29.36±5.15 <sup>c</sup>	
	7 <sup>th</sup> Day	24.33±2.08	26.33±2.08	29.33±2.08	30.67±2.52	32.00±2.00	28.53±3.44	
2501	10 <sup>th</sup> Day	36.33±5.51	34.33±4.51	35.67±1.53	37.67±3.21	34.00±2.00	35.60±3.40	
25%	14 <sup>th</sup> Day	38.67±1.53	37.33±2.08	40.33±1.53	41.33±2.08	39.33±1.53	39.40±2.06	
	Overall	33.11±7.32	32.67±5.61	35.11±5.01	36.56±5.22	35.11±3.66	34.51±5.43 <sup>d</sup>	
	7 <sup>th</sup> Day	25.33±2.08	31.00±1.00	32.67±4.16	30.33±2.52	29.33±2.52	29.73±3.39	
500	10 <sup>th</sup> Day	38.67±2.08	40.00±2.00	41.33±2.08	37.67±3.06	35.33±2.52	38.60±2.92	
50%	14 <sup>th</sup> Day	45.33±4.16	43.00±3.00	50.00±4.00	41.67±2.08	39.33±3.79	43.87±4.78	
	Overall	36.44±9.18	38.00±5.72	41.33±8.12	36.56±5.46	34.67±5.07	37.40±6.96 <sup>e</sup>	
	7 <sup>th</sup> Day	19.87±4.64	22.67±5.83	26.80±5.23	27.20±4.41	25.40±5.36		
Ommell	10 <sup>th</sup> Day	30.00±7.72	30.67±6.87	31.13±7.69	31.40±6.53	28.60±6.19		
Overall	14 <sup>th</sup> Day	33.00±8.87	33.87±6.82	36.73±8.55	34.87±7.04	33.73±5.85		
	Overall	$27.62 \pm 9.12^{a}$	29.07±7.96 <sup>ab</sup>	31.56±8.23 <sup>c</sup>	$31.16 \pm 6.75^{\circ}$	$29.24 \pm 6.65^{b}$		

Overall $27.62\pm9.12^{a}$  $29.07\pm7.96^{ab}$  $31.56\pm8.23^{c}$  $31.16\pm6.75^{c}$  $29.24\pm6.65^{b}$ Note:F=15.446;P<0.005</td>Variance between cultivar,F=239.631;P<0.005</td>Variance between concentration,2-way interaction,F=2.220;P<0.005.Variance between different concentration and cultivars. Overall means followed by the same letter within a columns and rows of overall</td>

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are not significantly different when subjected to Tukey's mean range test (P<0.05)

Reducing sugar of five paddy cultivars with different dilutions of distillery effluent at different time intervals of germinating seedlings							
Concentration	Duration	Jaya	Jyothi	Mangala	Mandya vijaya	MTU 1001	Overall
Control	7 <sup>th</sup> Day	29.67±1.53	26.00±2.00	30.33±1.53	25.67±2.08	33.67±2.08	29.06±3.45
	10 <sup>th</sup> Day	34.33±1.53	34.00±1.73	40.33±2.52	31.33±2.08	40.00±2.65	36.00±4.11
	14 <sup>th</sup> Day	40.00±1.00	42.67±3.06	45.33±2.08	39.00±1.00	48.67±4.51	43.13±4.31
	Overall	34.67±4.64	34.22±7.50	38.67±6.86	32.00±6.00	40.78±7.10	36.07±6.99 <sup>e</sup>
	7 <sup>th</sup> Day	30.33±1.53	26.67±2.08	29.67±1.53	25.33±2.08	34.33±3.51	29.27±3.77
( 01	10 <sup>th</sup> Day	33.33±6.11	31.00±2.65	41.67±2.08	29.00±1.00	37.00±3.00	34.40±5.49
0%	14 <sup>th</sup> Day	41.33±3.06	39.00±1.00	44.67±4.16	39.00±3.00	44.67±4.62	41.73±3.90
	Overall	35.00±6.04	32.22±5.70	38.67±7.30	31.11±6.41	38.67±5.68	35.13±6.76 <sup>d</sup>
	7 <sup>th</sup> Day	24.33±1.54	20.33±1.53	26.00±2.00	20.33±2.52	25.67±2.08	23.33±3.09
100	10 <sup>th</sup> Day	28.67±2.52	26.00±2.00	31.00±2.00	24.67±2.52	31.67±1.15	28.40±3.33
12%	14 <sup>th</sup> Day	37.00±3.00	34.67±0.58	36.00±2.00	25.67±6.11	39.67±7.23	34.60±6.25
	Overall	30.00±5.96	27.00±6.38	31.00±4.66	23.56±4.30	32.33±7.18	28.78±6.38 <sup>c</sup>
	7 <sup>th</sup> Day	19.00±1.00	18.67±1.53	18.33±2.08	17.67±1.53	20.67±0.58	18.87±1.60
250%	10 <sup>th</sup> Day	22.67±2.08	23.00±1.00	22.67±3.06	16.67±5.13	26.33±1.53	22.27±4.08
25 %	14 <sup>th</sup> Day	28.00±1.73	35.67±5.51	29.00±1.00	23.67±0.58	30.33±2.52	29.33±4.69
	Overall	23.22±4.18	25.78±8.18	23.33±5.02	19.33±4.24	25.78±4.47	23.49±5.70 <sup>b</sup>
	7 <sup>th</sup> Day	16.67±1.15	16.67±1.53	19.67±2.52	15.00±1.00	21.33±2.52	17.87±2.85
50%	10 <sup>th</sup> Day	21.00±2.65	21.00±3.00	23.00±3.00	19.00±1.00	23.00±3.00	21.40±2.72
50 /0	14 <sup>th</sup> Day	25.00±1.00	28.33±2.08	25.00±1.00	22.00±2.00	27.33±1.53	25.53±2.64
	Overall	20.89±3.92	22.00±5.48	22.56±3.0*	18.67±3.28	23.89±3.41	21.60±4.15 <sup>a</sup>
	7 <sup>th</sup> Day	24.00±5.81	21.67±4.39	24.80±5.41	20.80±4.63	27.13±6.39	
Overall	10 <sup>th</sup> Day	28.00±6.29	27.00±5.36	31.73±8.71	24.13±6.28	31.60±6.87	
Overall	14 <sup>th</sup> Day	34.27±7.04	36.07±5.56	36.00±8.67	29.87±8.27	38.13±9.28	
	Overall	28.76±7.57 <sup>b</sup>	28.24±7.83 <sup>b</sup>	30.84±8.90 <sup>c</sup>	24.93±7.45 <sup>a</sup>	32.28±8.74 <sup>c</sup>	

Table-5

Note: F=; 50.667; P<0.005 Variance between cultivar, F=278.851; P<0.005 Variance between concentration, 2-way interaction, F=2.933; P<0.005.Variance between different concentration and cultivars. Overall means followed by the same letter within a columns and rows of overall are not significantly different when subjected to Tukey's mean range test (P<0.05)

#### Table-6 Total protein content of five paddy cultivars with different dilutions of distillery effluent at different time intervals of germinating seedlings

			germmatn	ig securings			
Concentration	Duration	Jaya	Jyothi	Mangala	Mandya vijaya	MTU 1001	Overall
	7 <sup>th</sup> Day	7.33±.58	9.00±1.00	8.67±1.53	6.00±2.00	5.50±0.50	7.30±1.79
Control	10 <sup>th</sup> Day	10.67±.58	11.33±1.53	$10.00 \pm 2.00$	7.33±2.08	$8.00 \pm 1.00$	9.47±2.07
Control	14 <sup>th</sup> Day	13.33±.58	13.33±0.58	11.67±2.52	10.00±2.00	$9.00 \pm 1.00$	11.47±2.23
	Overall	10.44±2.65	11.22±2.11	10.11±2.20	7.78±2.49	7.50±1.73	$9.41 \pm 2.63^{d}$
	7 <sup>th</sup> Day	8.00±.50	10.00±1.00	8.33±2.52	6.33±1.15	6.00±1.00	7.73±1.92
60%	10 <sup>th</sup> Day	11.67±.58	11.17±1.04	9.67±3.06	7.67±2.25	7.33±0.76	9.50±2.38
0 70	14 <sup>th</sup> Day	12.00±1.00	12.67±1.15	10.50±1.32	8.00±3.61	$9.00 \pm 1.00$	10.43±2.43
	Overall	10.56±2.02	$11.28 \pm 1.48$	9.50±2.29	7.33±2.33	7.44±1.53	$9.22 \pm 2.48^{d}$
	7 <sup>th</sup> Day	7.33±.29	7.67±1.04	9.00±1.00	7.00±1.73	5.50±0.50	7.30±1.46
1207	10 <sup>th</sup> Day	8.50±.50	8.83±0.76	9.67±1.53	7.17±2.02	$6.50 \pm 0.50$	8.13±1.58
12%	14 <sup>th</sup> Day	9.67±.58	10.67±1.15	12.00±1.00	8.50±1.80	7.67±0.58	9.70±1.85
	Overall	8.50±1.09	9.06±1.57	10.22±1.72	7.56±1.75	6.56±1.04	8.38±1.89 <sup>c</sup>
	7 <sup>th</sup> Day	5.83±.29	6.00±1.00	7.67±0.58	5.00±1.00	5.33±1.53	5.97±1.26
2501	10 <sup>th</sup> Day	7.47±.45	5.83±1.44	8.33±2.31	6.50±1.32	6.83±1.76	6.99±1.60
25%	14 <sup>th</sup> Day	8.67±.58	8.00±2.00	9.17±.76	7.83±1.89	7.67±1.53	8.27±1.37
	Overall	7.32±1.29	6.61±1.69	8.39±1.41	6.44±1.76	6.61±1.73	7.07±1.68 <sup>b</sup>
	7 <sup>th</sup> Day	4.33±.58	6.00±2.00	5.67±1.53	4.50±0.87	4.33±0.58	4.97±1.29
50.0%	10 <sup>th</sup> Day	6.50±.50	6.17±1.04	7.00±1.73	5.83±1.04	5.67±1.53	6.23±1.16
50 %	14 <sup>th</sup> Day	7.67±.58	6.00±1.00	8.67±1.53	7.17±0.76	6.00±1.00	7.10±1.37
	Overall	6.17±1.54	6.06±1.24	7.11±1.90	5.83±1.39	5.33±1.22	6.10±1.53 <sup>a</sup>
	7 <sup>th</sup> Day	6.57±1.43	7.73±1.97	7.87±1.81	5.77±1.52	5.33±0.96	
Overall	10 <sup>th</sup> Day	8.96±2.05	8.67±2.64	8.93±2.19	6.90±1.67	6.87±1.30	
Overall	14 <sup>th</sup> Day	10.27±2.25	10.13±3.07	10.40±1.89	8.30±2.11	7.87±1.46	
	Overall	8.60±2.45 <sup>b</sup>	8.84±2.73 <sup>b</sup>	9.07±2.19 <sup>b</sup>	6.99±2.04 <sup>a</sup>	6.69±1.62 <sup>a</sup>	

Note: F=28.903; P<0.005 Variance between cultivar, F=47.281; P<0.005 Variance between concentration, 2-way interaction, F=3.342; P<0.005.Variance between different concentration and cultivars. Overall means followed by the same letter within a columns and rows of overall are not significantly different when subjected to Tukey's mean range test (P<0.05).

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