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## Supplementary Material

### **Alteration in plant spacing improves submergence tolerance in Sub1 and non-Sub1 rice (cv. IR64) by better light interception and effective carbohydrate utilisation under stress**

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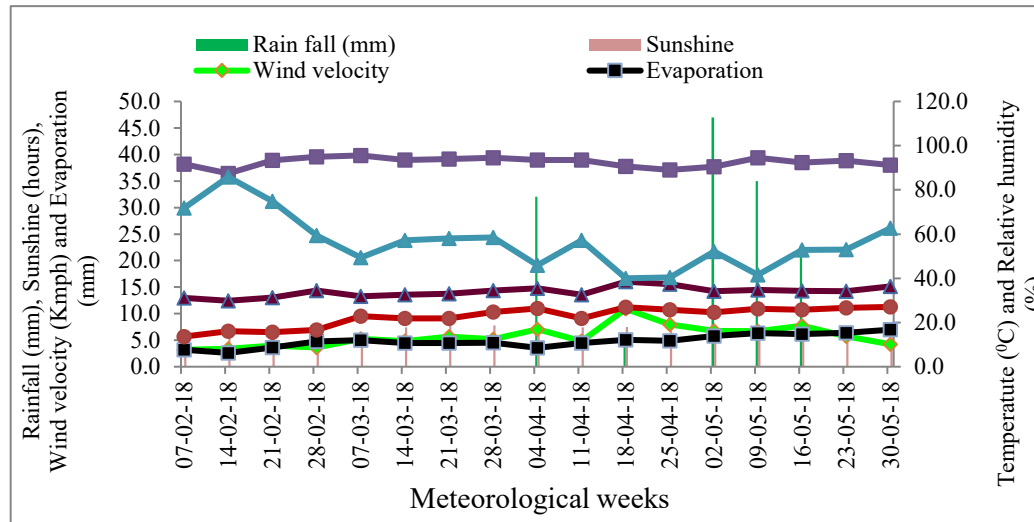
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**Table S1. Water quality parameters during the period of submergence**

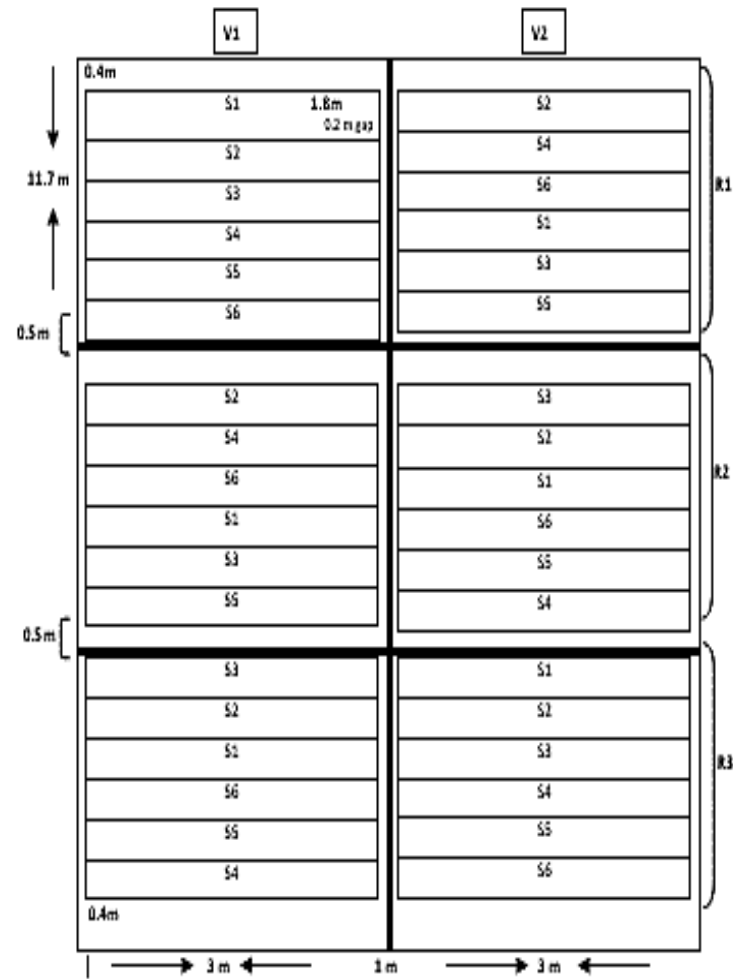
ORP: Oxidation-reduction potential; EC: Electrical conductivity; DO: Dissolved oxygen; TDS: Total dissolved solids; PPT: Precipitation; NTU: Nephelometric Turbidity Units

	<b>0-15 cm</b>							
Days of observation	Temperature	pH	ORP (mv)	EC (mS cm <sup>-1</sup> )	DO (mg L <sup>-1</sup> )	TDS	PPT	NTU
Day 1	27.03	7.81	74.33	0.14	1.286	0.92	0.1	--
Day 2	26.71	6.73	137.33	0.14	0.436	0.09	0.1	45.76
Day 3	26.58	7.1	106	0.14	0.573	0.596	0.096	32.76
Day 4	26.60	6.57	212.33	0.14	0.571	0.09	0.10	42.10
Day 5	25.53	6.73	66.40	0.13	0.23	0.34	0.10	49.97
Day 6	26.37	6.70	112.33	0.13	0.60	0.08	0.10	57.67
Day 7	28.14	6.40	130.00	0.10	0.67	0.06	0.10	42.87
Day 8	26.00	6.07	142.33	0.14	0.64	0.09	0.10	30.53
Day 9	28.14	6.40	113.33	0.10	0.67	0.06	0.07	42.87
Day 10	26.00	6.07	142.33	0.14	0.67	0.09	0.10	30.53
Day 11	27.10	6.27	155.67	0.08	0.08	0.26	0.30	14.97
	<b>15-30 cm</b>							
Day 1	26.56	7.43	126	0.14	1.27	0.675	0.1	--
Day 2	26.82	6.74	144.33	0.14	0.3	0.09	0.1	44.73
Day 3	26.57	6.95	117.33	0.14	0.31	0.089	0.1	30.9
Day 4	26.43	6.30	194.33	0.14	0.55	0.09	0.10	32.23
Day 5	25.42	6.56	92.00	0.10	0.44	0.09	0.10	51.96
Day 6	26.20	6.28	132.00	0.14	0.13	0.09	0.10	47.20
Day 7	28.15	6.33	141.00	0.12	0.18	0.08	0.33	24.17
Day 8	28.64	5.99	156.33	0.14	0.42	0.09	0.10	26.87

Day 9	28.15	6.33	141.00	0.12	0.18	0.08	0.33	17.10
Day 10	28.64	5.99	156.33	0.14	0.42	0.09	0.10	26.87
Day 11	27.33	6.00	160.00	0.10	0.17	0.06	0.33	19.53
	<b>30-45 cm</b>							
	Temperature	pH	ORP (mv)	EC (mS cm <sup>-1</sup> )	DO (mg L <sup>-1</sup> )	TDS	PPT	NTU
Day 1	26.4	7.17	140.66	0.136	1.3	0.97	0.1	--
Day 2	26.72	6.76	149.66	0.138	0.27	0.09	0.1	40.96
Day 3	26.48	6.78	134.66	0.145	0.49	0.356	0.1	69.5
Day 4	25.97	6.37	185.00	0.14	0.54	0.08	0.10	40.03
Day 5	25.15	6.47	104.33	0.16	0.44	0.09	0.10	61.69
Day 6	26.14	6.28	135.00	0.14	0.22	0.09	0.10	43.17
Day 7	28.11	6.41	176.00	0.14	0.17	0.09	0.33	44.90
Day 8	27.87	5.85	177.00	0.14	0.30	0.35	0.10	97.30
Day 9	28.11	6.41	176.00	0.14	0.17	0.09	0.33	52.65
Day 10	27.87	5.85	177.00	0.14	0.30	0.17	0.10	97.30
Day 11	27.49	5.61	169.33	0.13	0.28	0.09	0.10	27.60



**Fig. S1.** Detailed weather condition during experimental period as recorded in meteorological observatory of ICAR-NRRI, Cuttack.



**Fig. S2.** Plot design (actual field layout) of the experiment.

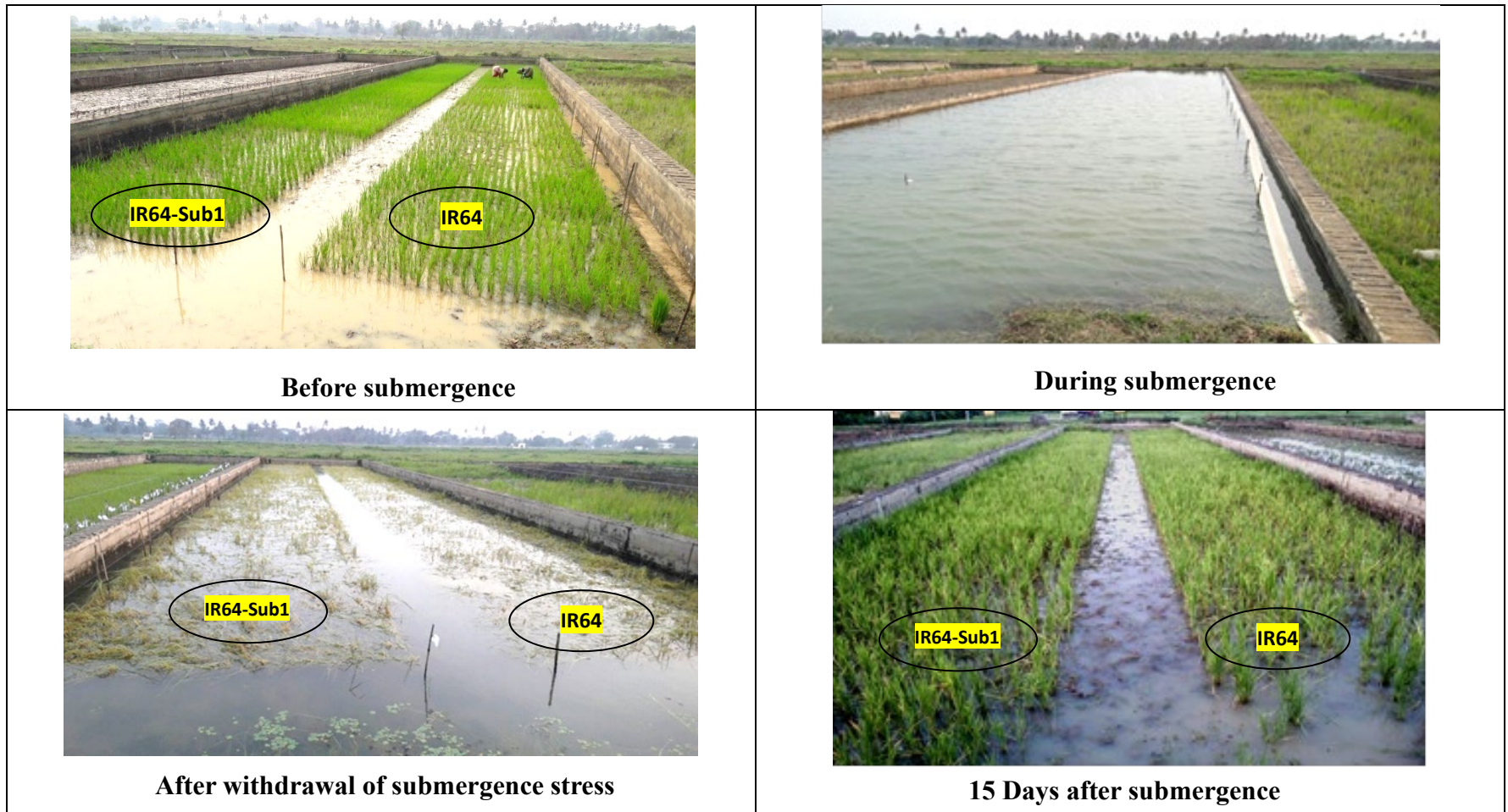
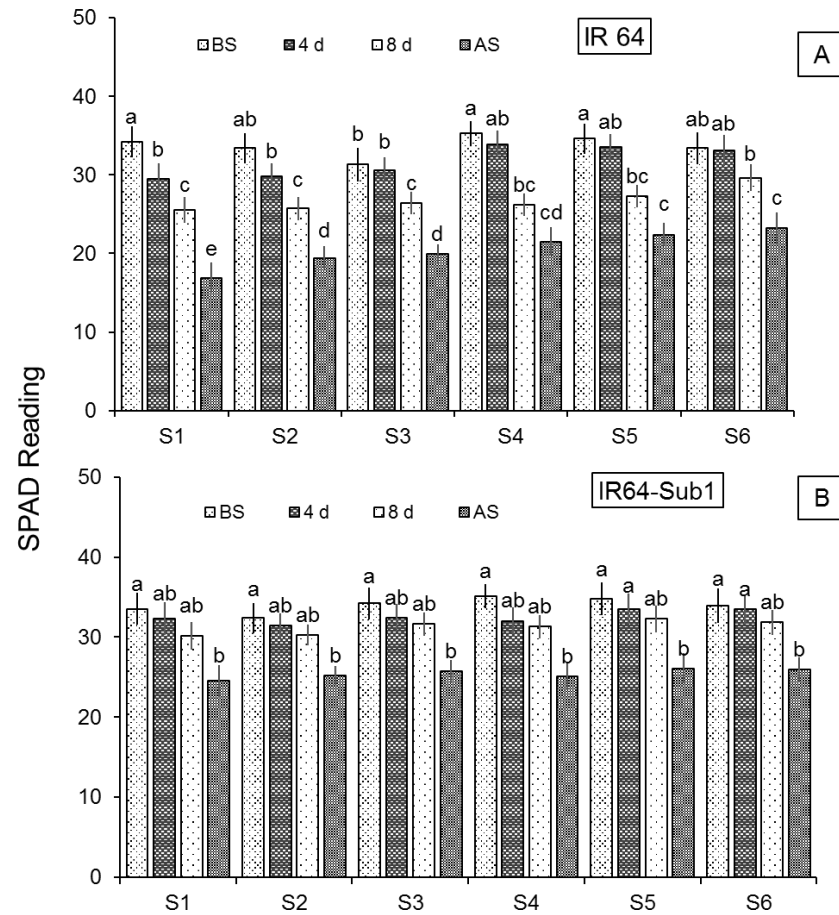
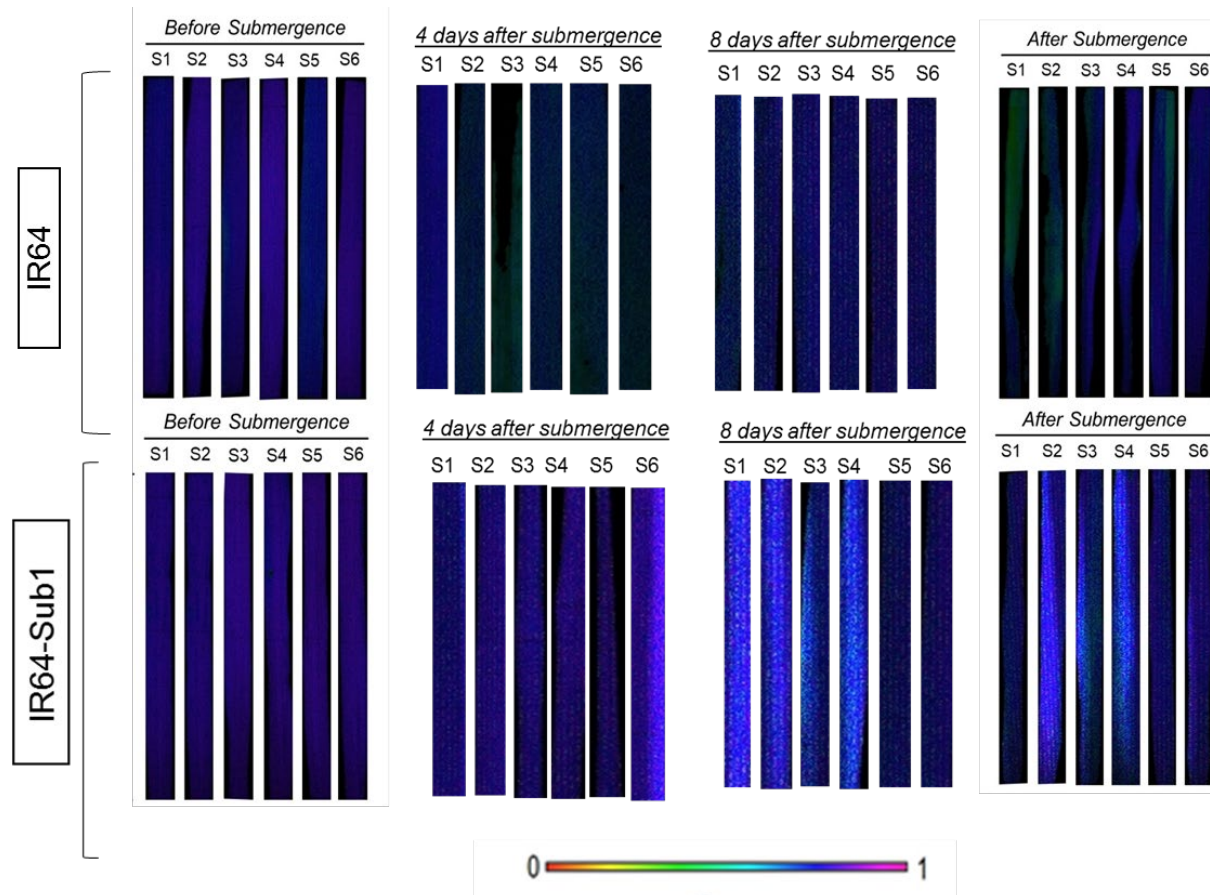


Fig. S3. Different times of submergence experiment (before, during and after treatment situations).

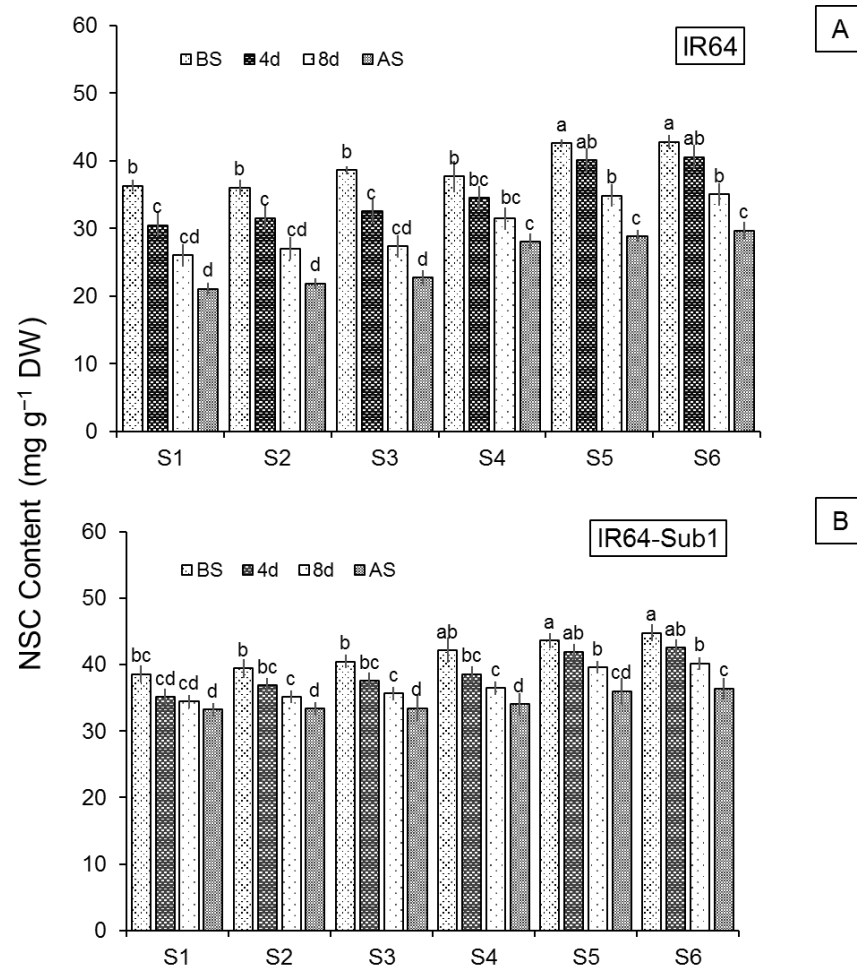


**Fig. S4.** Changes in SPAD chlorophyll meter reading of before (BS), 4-days (4 d) and 8-days (8 d) of submergence, and after submergence (AS) conditions of (A) IR64 and (B) IR64-Sub1 at six different crop spacing. Different lowercase letters above the bars indicates treatments are significantly different ( $P < 0.05$ ) following two-tailed Tukey's test.

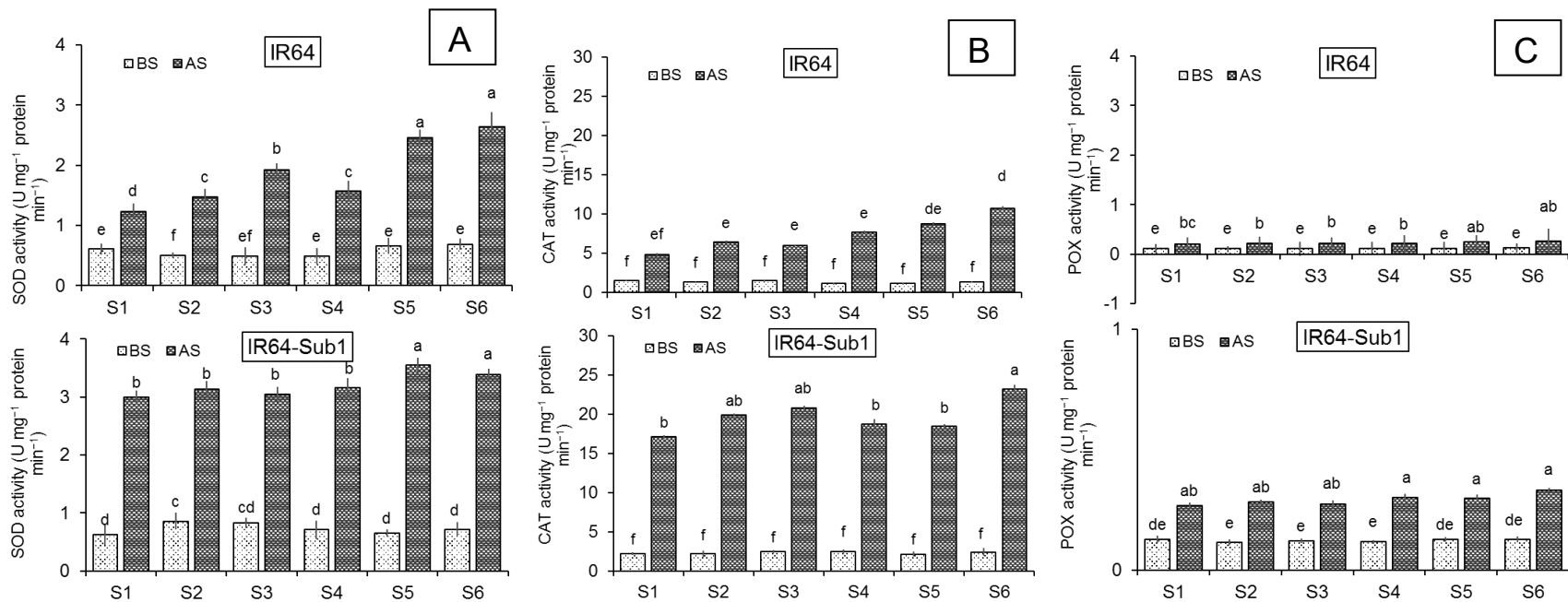


**Fig. S5.** Chlorophyll fluorescence imaging for Fv/Fm of before, 4-days and 8-days of submergence, and after submergence conditions of IR64 and IR64-Sub1 at six different crop spacing. Different lowercase letters above the bars indicates treatments are significantly different ( $P < 0.05$ ) following two-tailed Tukey's test. Reference scale of (0–1) shows the intensity of color of the imaging parameters.





**Fig. S6.** Changes in content of non-structural carbohydrate ( $\text{mg g}^{-1}$  DW) of before (BS), 4-days (4 d) and 8-days (8 d) of submergence, and after submergence (AS) conditions of (A) IR64 and (B) IR64-Sub1 at six different crop spacing. Different lowercase letters above the bars indicates treatments are significantly different ( $P < 0.05$ ) following two-tailed Tukey's test.



**Fig. S7.** Variation in antioxidant enzymes i.e. (A) superoxide dismutase (SOD), (B) catalase (CAT) and (C) peroxidase (POX) of IR64 and IR64-Sub1 at six different crop spacing. Different lowercase letters above the bars indicates treatments are significantly different ( $P < 0.05$ ) following two-tailed Tukey's test.