The Pharma Innovation Journal 2023; 12(11): 2221-2227

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(11): 2221-2227

www.thepharmajournal.com
Received: 02-08-2023
Accepted: 04-09-2023

Bhimrao G Thaware
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Ajay V Narwade
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Kirti Bhardhan
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Nilima Karmakar
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Kamal Kant
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Patik B Patel
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Alok Shrivastava
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
Bhimrao G Thaware
Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Characterization of rice (*Oryza sativa* L.) genotypes in response to potassium application under water stress

Bhimrao G Thaware, Ajay V Narwade, Kirti Bhardhan, Nilima Karmakar, Kamal Kant, Patik B Patel and Alok Shrivastava

Abstract
Among environmental stresses, drought is the most devastating abiotic stress faced by crops across the world. Rice is known to be a water loving plant and thus, the stress is one of the major obstacles in rice production. Therefore, there is an urgent need to identify the tolerant traits which can be helpful to mitigate the problem of drought stress. Besides, the optimal K nutrition can be seen as a functional approach owing to its miracle role in improving drought tolerance in the plants. Hence to address this question, a pot experiment was conducted in open conditions at Department of Plant Physiology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, during *Rabi* 2021 to study the "characterization of rice (*Oryza sativa* l.) genotypes in response to potassium application under water stress". The treatments for pot experiments were comprised of two levels of water regime *viz*., no water stress (I1, 100%) field capacity and water stress (I2, 50%) field capacity along with two levels of K fertilizer *viz*., (K1, 20 ppm K) and (K2, 40 ppm K). The seeds of twenty genotypes, were sown in plastic bags and after the seedling emergence, plants were irrigated and fertilized as per treatments during the course of experimentation. The treatments were laid out in a Completely Randomized Design (CRD) with factorial concept accompanied by three repetitions.

Keywords: Rice, water stress, potassium

Introduction
Rice (*Oryza sativa* L.) is one of the most important staple food crop that has been cultivated for thousands of years and is a key part of the global food system. It is one of the most important cereal crops in the world, providing food for billions of people, particularly in Asia, where it is a dietary staple and it is an essential crop for global food security. According to the Food and Agriculture Organization (Anon., 2021) [2], rice is the world's second most important crop after wheat, with an estimated crop area in 2021 was approximately 167 million hectares, with a total production of about 503 million tons, resulting in an average productivity of 3 tons per hectare. India and China are the two largest rice-producing countries in the world, with a combined share of around 55% of global production. India is the world's largest rice producer, accounting for approximately 25% of global rice production. India's rice crop area was about 44 million hectares, and the total production was approximately 118 million tons, with an average productivity of about 2.7 tons per hectare. Within India, the state of West Bengal is the largest rice producer, followed by Uttar Pradesh and Punjab. Gujarat is one of the major rice-producing states in India. In 2020, the rice crop area in Gujarat was about 1.3 million hectares, and the total production was approximately 3.6 million tons, with an average productivity of about 2.8 tons per hectare.
The global population is projected to reach 9.7 billion by 2050, an increase of nearly 30% from the current population of 7.8 billion (Anon., 2020) [1]. As the world population continues to grow, the demand for rice, a staple food for more than half of the world's population, is also expected to increase. A report by the International Rice Research Institute (IRRI) forecasts that the global demand for rice will increase by about 30% by 2050, due to population growth, rising incomes, and changing dietary habits (IRRI, 2021) [8]. The report also notes that rice demand is increasing faster in Africa than in any other region, as the continent's population is expected to double by 2050.
In light of the increasing demand for varietal improvement, the evaluation and characterization of existing rice landraces have become crucial. Characterization involves the use of techniques to assess phenotypic diversity based on agro-morphological traits. This method has proved to be effective in identifying exceptional individual genotypes, and it is an essential tool for

selecting varieties or lines based on agronomic, morphological, genetic traits or physiological features. Characterization of accessions is necessary for evaluating the phenotypic diversity based on agro-morphological traits, which is crucial for managing gene banks to safeguard unique rice varieties (Bajracharya *et al*., 2020) [3].

Drought is the most common and complex phenomenon that can occur at any time for a long time, affecting a large array of physiological, biochemical and molecular processes (Muthurajan *et al*., 2011) [12]. Drought stress is the insufficiency of moisture content in the soil resulting in the reduction of growth, development and yield of rice plants (Pandey and Bhandari, 2008) [16]. To cope with drought stress, different morphological, biochemical and physiological adaptations are there morphological characteristics like root/shoot length, leaf area, leaf length and width are affected by drought stress (Rama Rao, 1986) [18]. To survive under stress there is an increase in root length and a decrease in leaf area (Banoc *et al*., 2000) [4]. The rice plant can avoid drought stress through increased root length which helps the plant to extract water from deeper soil layers and decreased transpiration rate by the leaf rolling (Chaturvedi *et al*., 2017) [6]. Secondly, rice can escape from drought through the short growth duration of genotype to avoid terminal drought stress.

Potassium plays a significant role in improving the drought tolerance of rice. The mechanisms by which potassium enhances drought tolerance in rice are diverse, including regulating stomatal opening, maintaining water uptake, and promoting osmoregulation. Several studies have shown that potassium application can improve the drought tolerance of rice by improving physiological and biochemical responses, regulating gene expression, and promoting water uptake.

2. Materials and Methods

In the current research work, rice seeds were collected from the main rice research station, Navsari Agricultural University, Navsari and experiment was conducted at Department of Plant Physiology, N. M. college of Agriculture, Navsari Agricultural University, Navsari, Gujrat during *rabi* 2021.

2.1 Experimental details

The experiment was laid out in a Completely Randomized Design (CRD) with Factorial concept accompanied by three replications. The treatments for experiment were comprised of two levels of water regime *viz*., no water stress (I_1, 100%) field capacity and water stress (I_2, 50%) field capacity along with two levels of K fertilizer *viz*., (K_1, 20 ppm K) and (K_2, 40 ppm K). The seeds of twenty rice (NVSR 3260, NVSR 3265, NVSR 3266, NVSR 3269, NVSR 3273, NVSR 3278, NVSR 3282, NVSR 688, IR 64, Mashuri, Gurjari, Ambemore, Rajbangalo, Dandi, GNR 3, Narmada, Lalkada, Purna, Pokhali and Mahisagar) were sown in six plastic bags/treatment/replication and after the seedling emergence, plants were irrigated and fertilized as per treatments.

2.2 Growing Bags and Media

The white coloured plastic bags having the height and diameter of 60 cm and 15 cm, respectively were used for filling up media according to IIRI (SES) standard evaluation system given by Turner *et al.*, (1986) [19]. The media was prepared by mixing coarse sand and soil with a ratio of 1:1 (w/w). Both soil and sand were sieved by 2.0 mm and 0.2 mm sieves, separately and then, media was prepared by sieve size of 2.0 to 0.2 mm particles. For each bag, 2.5 kg sand and 2.5 kg soil were mixed together, homogenized manually and then filled in bag for the sowing of rice seeds. It was mixture of fine and coarse sized soil and sand particles. The growing media was light grey to white. The homogenised mixture was then filled in the bag to sow rice seeds.

2.3 Yoshida's Stock Solution

Modified Yoshida solution, specially formulated for rice plants (Yoshida *et al*., 1976) [20], was used for supplying the nutrients through fertigation as per treatments of water stress and potassium levels. The Yoshida stock solution was prepared by dissolving different analytical grade chemicals *viz*., NH_4NO_3, NaH_2PO_4, K_2SO_4, $CaCl_2.2H_2O$, $MgSO_4.7H_2O$, $MnCl_2.4H_2O$, $(NH_4)_6Mo_7O_{24}.4H_2O$, H_3BO_3, $ZnSO_4.7H_2O$, $CuSO_4.5H_2O$, $FeCl_3.6H_2O$, H_2SO_4 and citric acid (monohydrate).

2.4 Moisture stress impositions

Before the experimentation, Field capacity / water holding capacity of growing media was estimated by gravimetric method. Four bags were filled with pre-weighted oven dried (100 ± 2.0 °C temperature) media and the empty weight of bag plus media were noted. Bags containing media were saturated with excess water and kept overnight in such a way that the bottom of bag remained in contact with surface of soil, thus excess water, above field capacity was drained out through the small holes provided at the bottom of bags. Whereas, top of bags was sealed to avoid evaporation during night hours. Next morning, weight of moist media along with the bags was recorded and net weight of moist media was calculated and subsequently field capacity/water holding capacity of media was calculated by using following formula.

$$FC(\%) = \frac{\text{Weight of moist media (g)} - \text{Weight of dried media (g)}}{\text{Weight of dried media (g)}} \text{x } 100$$

On the basis of weight differences between moist media and dried media, amount of water required to attain field capacity was calculated from each bag and so obtained values were averaged out for further calculation.

In the experimental bags, four healthy seeds of rice were sown in each bag and then bags were irrigated with water 100% FC that is the maximum soil moisture content after drainage of excess water, resembling an aerobic condition at the time of sowing. After the complete emergence of rice seedling in all bags, only one healthy plant per bag was kept as an experimental plant. After the second week of emergence, plants were irrigated based on water stress treatments at one-day intervals throughout the experimentation as per water stress treatments *viz*. NWS - 100% FC (watering to attain 100% FC), and WS - 50% FC (watering to attain 50% FC).

For this, amount of water lost (g/bag) through evapotranspiration was estimated by weighing the four selected bags, identical to the experimental bags in all manners at an alternate day through gravimetric approach. The lost water was replenished in the form of water in different treatments to attain desired FC.

2.5 Potassium level implementation

In the experiment, the Yoshida solution was modified for different concentrations of K without modifying concentration of other nutrients,.The amount of Yoshida solution required to irrigate the experimental plants was estimated as per the water stress treatments and each bag was supplied with Yoshida solution accordingly. The solution was started to apply after seedling emergence and thinning practices.

3. Results and Discussion

3.1 Chlorophyll content (SPAD value)

Water stress significantly decreased the chlorophyll content of rice leaves, over no water stress condition and a significantly maximum chlorophyll content was observed under no water stress condition with a mean chlorophyll content of 28.65. Significantly minimum chlorophyll content was observed for rice plants that were grown under water stress condition with a mean of 26.56.

Potassium significantly increased the chlorophyll content with the application of 40 ppm K (K_2), recorded a significantly maximum chlorophyll content with attaining a mean of 28.58 as compared to normal dose of K (K_1) which recorded a mean chlorophyll content of 26.64.

The chlorophyll content of different rice genotypes exhibited significant differences and significantly maximum mean chlorophyll content was observed in Mahisagar (V_{20}) (31.15), followed by Dandi (V_{14}) (31.13), Mashuri (V_{10}) (30.82), IR 64 (V_9) (30.66) Ambemore (V_{12}) (29.70), NVSR 3278 (V_6) (29.06) and GNR 3(V_{15}) (28.03). A significant minimum chlorophyll content was observed in NVSR 3266 (V_3) (24.53).

Moisture levels and potassium availability (I x K), Moisture levels and genotypes (I x V), genotypes and potassium levels (K x V) and interactive effect of genotypes, different moisture regimes and potassium levels (I x K x V) not significantly interacted with each other and not influenced the chlorophyll content of rice leaves.

Chlorophyll content and canopy photosynthesis are also limited due to the reduction in moisture stress. It may be due to structural and functional disruptions of chloroplast and reduction of chlorophyll accumulation under drought stress (Lauteri *et al.*, 2014) [10] and/or loss of chloroplast membrane due to an increase in peroxidation of lipid and pigment degradation (Pirdashti *et al.*, 2009) [17]. This would also contribute to higher dry matter accumulation of rice under moisture stress due to potassium, besides maintaining leaf turgor and carbon assimilation. (Naser *et al.*, 2012) [14] reported that the application of potassium could minimize the reduction of chlorophyll a, b, and total chlorophyll content during water stress. The increase in chlorophyll content with increased potassium application might be due to an increase in nitrate reductase enzyme.

3.2 Leaf Area (cm^2)

Water stress significantly decreased the leaf area of rice, over no water stress condition and a significantly minimum leaf area was observed under water stress with a mean area of 68.40 cm^2. Significant maximum leaf area was observed for rice plants which were grown under no water stress condition with a mean area of 70.83 cm^2.

Potassium significantly increased the leaf area and the application of 40 ppm K (K_2) recorded a significant maximum leaf area attaining a mean area of 70.69 cm^2 as compared to normal dose of K (K_1) which recorded a mean area of 68.54 cm^2.

The leaf area of different rice genotypes exhibited significant difference and a significant maximum mean leaf area was observed in NVSR 688 (V_8) (80.21 cm^2), followed by Gurjari (V_{11}) (76.02 cm^2) and NVSR 3269 (V_4) (75.71 cm^2). Significantly minimum leaf area was observed in Narmada (V_{16}) (62.57 cm^2). Moisture levels and potassium availability significantly interacted with each other and influenced the leaf area of rice. Application of a higher dose of K, showed a change in the leaf area per plant under no water stress as compared to the normal dose of K. However, under water stress condition, higher dose of K application significantly increased the leaf area over the normal dose of K supply under respective moisture regimes.

The leaf area of rice genotypes was also significantly influenced by different moisture regimes. Rice genotypes (V_4, V_{11}, V_{12}, and V_{13}) significantly decreased the leaf area under water stress conditions compared to no water stress, while all the other genotypes showed no significant influence in the leaf area due to water stress.

The leaf area of rice genotypes was not significantly influenced by K levels. A higher dose of K application (K_2) not significantly influenced the leaf area of rice genotypes.

The interactive effect of different moisture regimes and K levels significantly influenced the leaf area of rice genotypes. Under no water stress conditions, a higher dose of K (K_2) significantly increased the leaf area of NVSR 3282 (V_7) and Lalkada (V_{17}), while other genotypes showed no difference in leaf area due to higher K application under non-water stress conditions. Under water stress conditions, a higher dose of K significantly influence leaf area in NVSR 3260 (V_1), NVSR 3269 (V_4), NVSR 688 (V_8), Ambemore (V_{12}) and Mahisagar (V_{20}) while all other genotypes did not show a significant difference in leaf area due to higher K application compared to normal K levels.

Due to drought stress, there is a decrease in plant leaf and width and finally, a decrease in leaf area. The decrease in leaf area index under drought stress might be due to a reduction in cell division of meristematic tissue. The results of the experiment are in agreement with earlier work (Hossain, 2001) [7]. (Lindhauer 1985) [11] showed that K fertilization besides increasing dry matter production, leaf area also greatly improved the retention of water in the plant tissues even under conditions of severe water stress. (Carmeis *et al.*, 2017) [5] also reported that the potassium application greatly increased dry matter production and leaf area by retaining more water under drought conditions.

3.3 Plant Height (cm)

Water stress significantly decreased the genotypes height of rice over no water stress conditions and a significant minimum plant height was observed under water stress with a mean height of 20.61 cm. The significant maximum plant height was observed for rice genotypes which were grown under no water stress condition with a mean height of 22.61 cm.

The application of 40 ppm of potassium (K_2) significantly increased rice plant height, with a mean height of 22.54 cm, compared to the normal dose of potassium (K_1), which resulted in a mean height of 20.67 cm.

The plant height of different rice genotypes exhibited significant differences and a significant mean maximum height was observed in Rajbangalo (V_{13}) (34.39 cm) which was at par with GNR 3 (V_{15}) (34.16 cm) and IR 64 (V_9) (33.59). Significant minimum plant height was recorded for

NVSR - 3266 (V_3) (13.98 cm).

Moisture levels and potassium availability significantly interacted with each other and influenced the plant height of rice. Application of a higher dose of K, significantly increased the plant height under no water stress whereas, under water stress condition higher dose of K, the plant height was not significantly influenced and remained at par over the normal dose of K supply under respective moisture regimes. However, rice plants that were grown under no water stress condition with a higher supply of K, attained a significant maximum plant height with a mean of 24.28 cm as compared to the counterpart with a normal K supply, a mean of 20.94 cm.

The plant height of rice genotypes was also influenced significantly and differently under varied moisture regimes. The plant height of all genotypes significantly decreased, while plant height of genotypes NVSR 3260 (V_2), NVSR 3266 (V_3), NVSR 3269 (V_4), NVSR 3273 (V_5), NVSR 688 (V_8), Mashuri (V_{10}), Purna (V_{18}) and Mahisagar (V_{20}) significantly did not influenced under water stress regimes over no water stress.

The plant height of rice genotypes is also significantly influenced by potassium levels. The higher dose of K application (K_2) significantly increased the plant height of all genotypes, while V_2, V_4, V_{10}, V_{12}, V_{14}, V_{15}, V_{17} and V_{20} significantly not influenced the plant height by application of a higher dose of K and remain similar with normal dose of K application.

The plant height of rice genotypes was significantly influenced due to the interactive effect of different moisture regimes and potassium levels. Under non water stress condition application of a higher dose of K (K_2), significantly increased the plant height over their counterpart with normal K supply in all rice genotypes, while V_3, V_4 and V_{20} rice genotypes were not influenced in plant height due to higher dose of K application over normal supply of K. Under water stress condition application of a higher dose of K significantly increase in plant height was observed in V_3, V_5, and V_{15} while all other genotypes showed no significant difference due to a higher dose of K application over a normal dose of K application under a similar moisture regime.

The plant height is rice's most important agronomic trait, which is controlled by environmental conditions. Plant height is attributed to the rate of culm elongation, number of internodes per plant, elongation in leaf and leaf blade. The culm is composed of a series of nodes and internodes. Internode elongation is closely associated with growth duration. Due to a decrease in turgor pressure, cell growth is sensitive to drought stress. During division in meristematic cells, the production of daughter cells, leads to an increase in cell growth. Less absorption of water by the xylem during stress conditions inhibits the division in meristematic cells due to less production of daughter cells and ultimately reduction in cell growth (Nonami, 1998) [15]. The results suggest that as drought stress increases there is a decrease in plant height. They are inversely related to each other. It might be due to the reduction in cell division or reduction in cell enlargement under drought stress (Islam *et al.*, 2001) [9]. Reduction in plant height under stress has been reported by many workers (Nadrajan and Kumaravelu, 1994) [13].

Table 1: Chlorophyll content of rice genotypes as influenced by different levels of K fertilizer under water stress condition

Treatments	NWS (100% FC)			WS (50% FC)			Mean (K x V)		Mean (V)
	K_1	K_2	Mean (NWS x V)	K_1	K_2	Mean (WS x V)	K1	K2	
V_1 (NVSR - 3260)	26.98	29.28	28.13	24.34	25.84	25.09	25.66	27.56	26.61
V_2 (NVSR - 3265	24.89	26.88	25.88	22.77	24.74	23.76	23.83	25.81	24.82
V_3 (NVSR - 3266)	25.11	27.11	26.11	22.28	23.63	22.95	23.70	25.37	24.53
V_4 (NVSR - 3269)	27.92	28.75	28.33	25.96	27.53	26.75	26.94	28.14	27.54
V_5 (NVSR - 3273)	27.17	29.77	28.47	25.42	26.51	25.97	26.29	28.14	27.22
V_6 (NVSR - 3278)	30.37	27.25	28.81	28.54	30.12	29.33	29.45	28.69	29.07
V_7 (NVSR - 3282)	27.69	29.74	28.71	25.62	27.08	26.35	26.65	28.41	27.53
V_8 (NVSR - 688)	27.00	29.01	28.00	25.62	27.34	26.48	26.31	28.18	27.24
V_9 (IR - 64)	30.95	32.93	31.94	28.48	30.28	29.38	29.71	31.60	30.66
V_{10} (Mashuri)	31.17	33.16	32.17	28.96	30.00	29.48	30.07	31.58	30.82
V_{11} (Gurjari)	26.67	28.80	27.74	24.48	25.93	25.21	25.58	27.37	26.47
V_{12} (Ambemore)	29.65	32.19	30.92	27.71	29.26	28.48	28.68	30.73	29.70
V_{13} (Rajbangalo)	26.13	29.47	27.80	24.67	26.58	25.63	25.40	28.03	26.71
V_{14} (Dandi)	30.91	33.20	32.06	28.53	31.89	30.21	29.72	32.55	31.13
V_{15} (GNR - 3)	25.94	28.30	27.12	28.19	29.69	28.94	27.07	28.99	28.03
V_{16} (Narmada)	24.07	29.59	26.83	21.66	23.41	22.53	22.87	26.50	24.68
V_{17} (Lalkada)	26.27	29.35	27.81	23.87	25.91	24.89	25.07	27.63	26.35
V_{18} (Purna)	25.60	29.31	27.46	23.91	24.99	24.45	24.75	27.15	25.95
V_{19} (Pokhali)	25.74	28.44	27.09	23.90	25.71	24.81	24.82	27.08	25.95
V_{20} (Mahisagar)	31.04	32.42	31.73	29.25	31.90	30.57	30.15	32.16	31.15
Mean (WS x K)	27.56	29.75		25.71	27.42				
Mean (K)	K_1: 26.64				K_2: 28.58				
Mean (WS)	NWS: 28.65				WS: 26.56				
ANOVA									
	SEm ±				CD @ 5%				CV (%)
WS	0.34				0.96				13.78
K	0.34				0.96				
V	1.09				3.05				
WS X K	0.49				NS				
WS X V	1.55				NS				
K X V	1.55				NS				
WS X K X V	2.19				NS				

NWS: No water stress (100% Field Capacity), WS: Water stress (50% Field Capacity), K_1: 20 ppm K, K_2: 40 ppm K

Table 2: Plant height (cm) of rice genotypes as influenced by different levels of K fertilizer under water stress condition

Treatments	NWS (100% FC)			WS (50% FC)			Mean (K x V)		Mean (V)
	K_1	K_2	Mean (NWS x V)	K_1	K_2	Mean (WS x V)	K1	K2	
V_1 (NVSR - 3260)	15.73	17.77	16.75	13.20	14.15	13.67	14.46	15.96	15.21
V_2 (NVSR - 3265	15.89	17.33	16.61	16.11	15.82	15.97	16.00	16.57	16.29
V_3 (NVSR - 3266)	13.31	13.54	13.43	13.37	15.70	14.53	13.34	14.62	13.98
V_4 (NVSR - 3269)	14.53	15.61	15.07	14.23	15.05	14.64	14.38	15.33	14.85
V_5 (NVSR - 3273)	14.26	21.67	17.96	16.38	19.10	17.74	15.32	20.38	17.85
V_6 (NVSR - 3278)	18.60	20.12	19.36	17.13	18.51	17.82	17.86	19.32	18.59
V_7 (NVSR - 3282)	21.48	26.97	24.22	20.09	20.47	20.28	20.79	23.72	22.25
V_8 (NVSR - 688)	19.41	21.17	20.29	19.52	20.15	19.83	19.46	20.66	20.06
V_9 (IR - 64)	30.49	45.09	37.79	28.88	29.84	29.36	29.68	37.46	33.57
V_{10} (Mashuri)	18.59	20.23	19.41	18.91	18.31	18.61	18.75	19.27	19.01
V_{11} (Gurjari)	33.52	36.68	35.10	24.04	24.34	24.19	23.78	30.51	27.15
V_{12} (Ambemore)	21.18	23.10	22.14	22.17	21.71	21.94	21.68	22.40	22.04
V_{13} (Rajbangalo)	34.86	39.52	37.19	31.48	31.71	31.60	33.17	35.61	34.39
V_{14} (Dandi)	17.63	19.43	18.53	17.36	16.93	17.15	17.50	18.18	17.84
V_{15} (GNR - 3)	34.59	37.94	36.27	30.61	33.51	32.06	34.05	34.28	34.16
V_{16} (Narmada)	17.66	20.57	19.11	17.03	18.77	17.90	17.35	19.67	18.51
V_{17} (Lalkada)	27.94	29.06	28.50	24.46	25.18	24.82	26.76	26.56	26.66
V_{18} (Purna)	22.46	24.25	23.36	22.60	23.19	22.89	22.53	23.72	23.13
V_{19} (Pokhali)	17.17	22.02	19.60	18.25	17.50	17.87	17.71	19.76	18.73
V_{20} (Mahisagar)	17.96	18.03	17.99	17.47	18.04	17.75	17.71	18.03	17.87
Mean (WS x K)	20.94	24.28		20.41	20.80				
Mean (K)	K_1 : 20.67				K_2: 22.54				
Mean (WS)	NWS: 22.61				WS: 20.61				
ANOVA									
	SEm ±				CD @ 5%				CV (%)
WS	0.22				0.61				11.27
K	0.22				0.61				
V	0.70				1.95				
WS X K	0.31				0.87				
WS X V	0.99				2.76				
K X V	0.99				2.76				
WS X K X V	1.40				3.91				

NWS: No water stress (100% Field Capacity), WS: Water stress (50% Field Capacity), K_1: 20 ppm K, K_2: 40 ppm K.

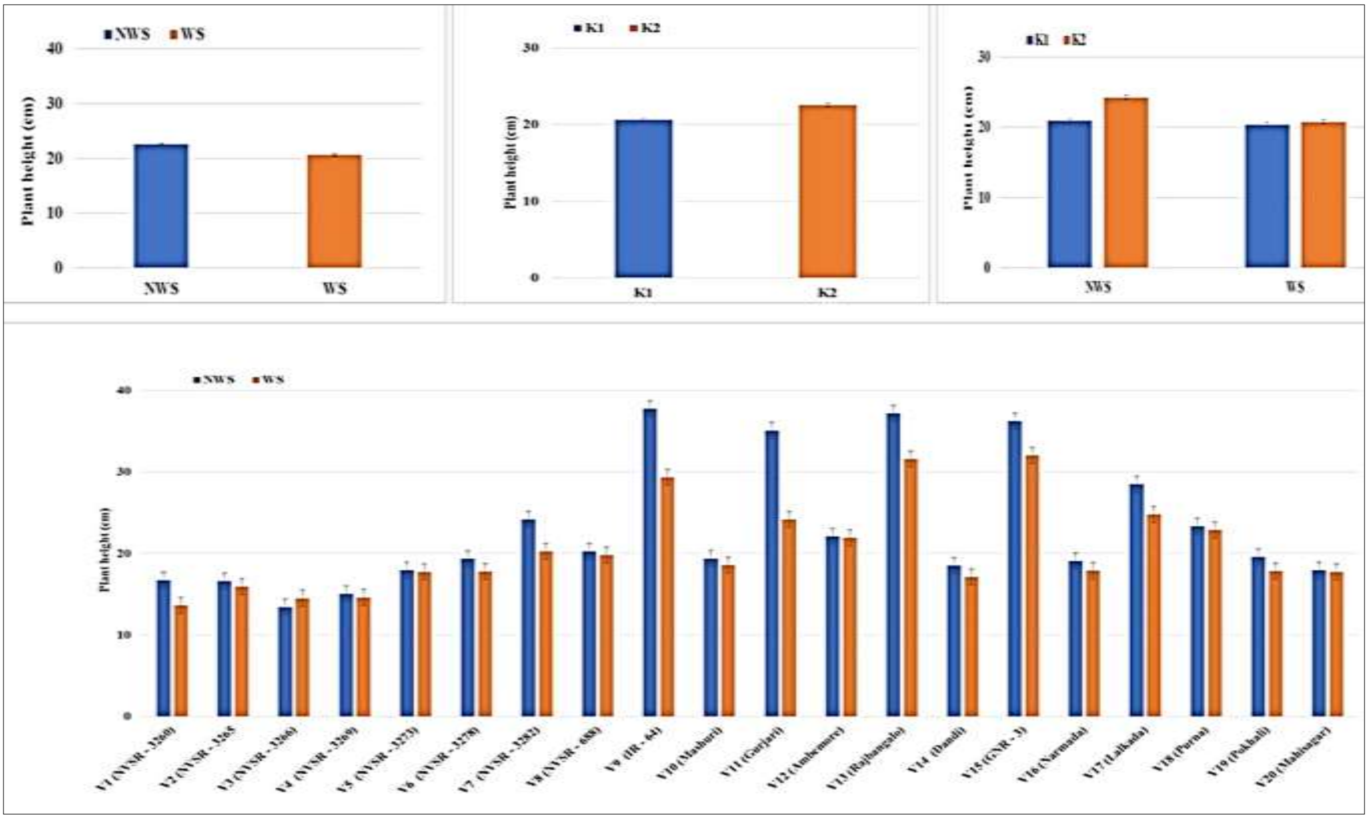

Fig 1: Plant height (cm) of rice genotypes as influenced by different levels of K fertilizer under water stress condition

Table 3: Leaf area (cm^2) of rice genotypes as influenced by different levels of K fertilizer under water stress condition

Treatments	NWS (100% FC)			WS (50% FC)			Mean (K x V)		Mean (V)
	K_1	K_2	Mean (NWS x V)	K_1	K_2	Mean (WS x V)	K1	K2	
V_1 (NVSR - 3260)	72.87	71.33	72.10	65.47	72.76	69.12	69.17	72.05	70.61
V_2 (NVSR – 3265	65.02	66.83	65.92	66.04	65.92	65.98	65.53	66.37	65.95
V_3 (NVSR - 3266)	64.18	61.95	63.06	61.83	63.66	62.74	63.00	62.80	62.90
V_4 (NVSR - 3269)	78.20	77.57	77.89	68.39	78.68	73.53	73.29	78.12	75.71
V_5 (NVSR - 3273)	72.94	73.50	73.22	72.38	73.42	72.90	72.66	73.46	73.06
V_6 (NVSR - 3278)	69.02	70.37	69.69	69.10	69.50	69.30	69.06	69.93	69.50
V_7 (NVSR - 3282)	61.54	68.78	65.16	63.28	62.68	62.98	62.41	65.73	64.07
V_8 (NVSR - 688)	82.71	81.48	82.09	73.36	83.30	78.33	78.03	82.39	80.21
V_9 (IR - 64)	69.57	68.32	68.94	68.20	69.38	68.79	68.88	68.85	68.87
V_{10} (Mashuri)	68.44	71.19	69.81	69.75	69.56	69.66	69.10	70.37	69.74
V_{11} (Gurjari)	84.21	81.76	82.98	68.72	69.40	69.06	76.47	75.58	76.02
V_{12} (Ambemore)	74.47	71.68	73.08	62.24	73.94	68.09	68.35	72.81	70.58
V_{13} (Rajbangalo)	73.50	78.37	75.94	69.30	73.98	71.64	71.40	76.17	73.79
V_{14} (Dandi)	72.32	72.20	72.26	71.42	72.80	72.11	71.87	72.50	72.18
V_{15} (GNR - 3)	70.52	68.31	69.41	66.48	72.04	69.26	68.50	70.17	69.33
V_{16} (Narmada)	61.00	66.25	63.63	61.22	61.81	61.51	61.11	64.03	62.57
V_{17} (Lalkada)	60.22	70.34	65.28	63.66	60.36	62.01	61.94	65.35	63.65
V_{18} (Purna)	72.59	71.45	72.02	69.83	73.58	71.70	71.21	72.51	71.86
V_{19} (Pokhali)	68.98	69.69	69.33	64.18	69.46	66.82	66.58	69.57	68.08
V_{20} (Mahisagar)	65.00	64.40	64.70	59.65	65.48	62.56	62.32	64.94	63.63
Mean (WS x K)	70.36	71.29		66.72	70.08				
Mean (K)	K_1 : 68.54				K_2: 70.69				
Mean (WS)	NWS: 70.83				WS: 68.40				
ANOVA									
	SEm ±				CD @ 5%				CV (%)
WS	0.32				0.90				5.09
K	0.32				0.90				
V	1.023				2.84				
WS X K	0.45				1.27				
WS X V	1.44				4.02				
K X V	1.44				4.02				
WS X K X V	2.04				5.69				

NWS: No water stress (100% Field Capacity), WS: Water stress (50% Field Capacity), K_1: 20 ppm K, K_2: 40 ppm K.

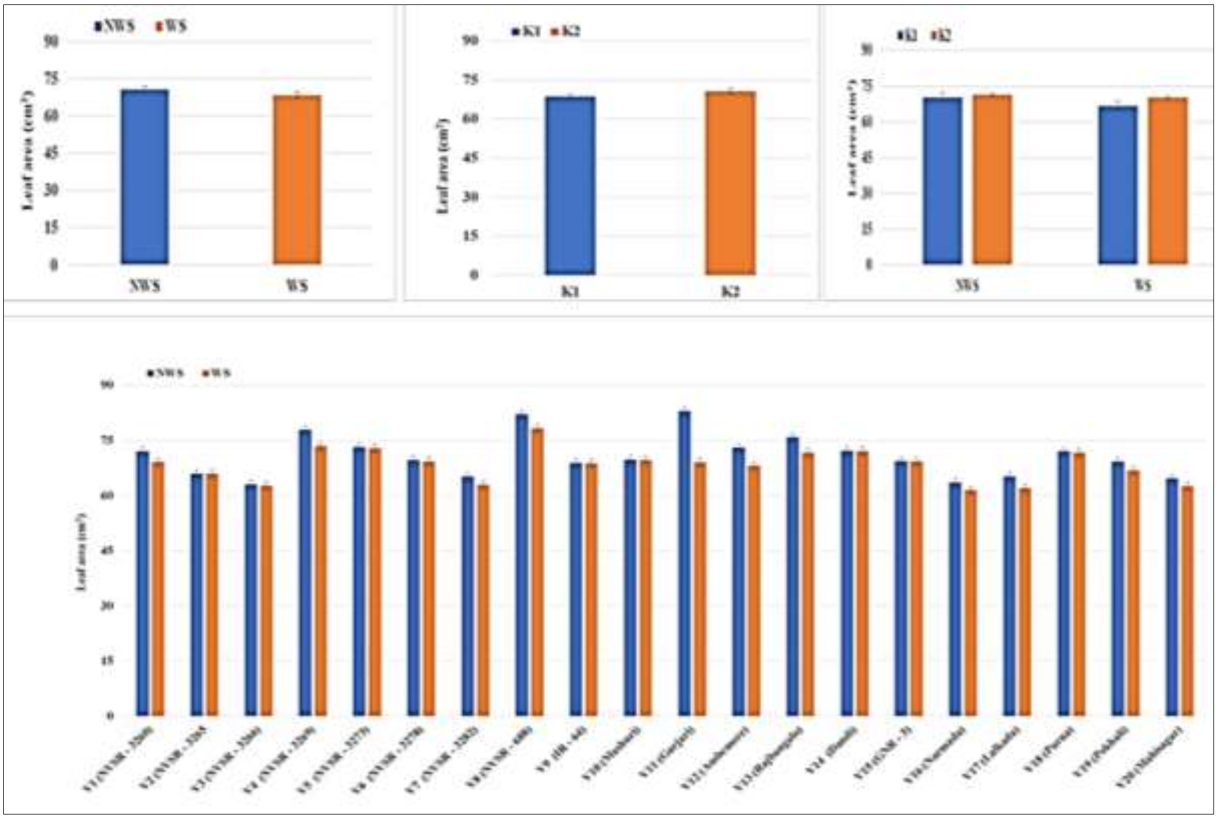

Fig 2: Leaf area (cm^2) of rice genotypes as influenced by different levels of K fertilizer under water stress condition

Conclusion
Potassium nutrition have a significant and distinctive impact on enhancing both the growth and yield parameters of rice genotypes under conditions of water stress. Additionally, leaf rolling trait found to play important role in identification of drought tolerance in rice genotypes under water stress. Further, current study will also help to understand the role of Potassium (K) and interrogation of root traits in the rice breeding programme for developing the tolerance mechanism under water stress.

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