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B Mahadeva Prabhu
Department of Crop Physiology, College of Agriculture, UAS, Gandhi Krishi Vigyana Kendra, Bengaluru, Karnataka, India

R Abhishree
Department of Crop Physiology, College of Agriculture, UAS, Gandhi Krishi Vigyana Kendra, Bengaluru, Karnataka, India

Corresponding Author:
B Mahadeva Prabhu
Department of Crop Physiology, College of Agriculture, UAS, Gandhi Krishi Vigyana Kendra, Bengaluru, Karnataka, India

Plant height in rice: Yield booster or barrier?

B Mahadeva Prabhu and R Abhishree

Abstract
This study examines the significance of understanding variability in plant height and tiller number in rice (*Oryza sativa* L.), crucial traits influencing yield potential and agricultural productivity. Plant height and tiller number, influenced by genetic, environmental, and management factors, exhibit considerable variability within and among rice varieties. Genetic diversity plays a pivotal role in shaping these traits, offering promising avenues for breeding high-yielding rice varieties tailored to diverse growing conditions. Environmental factors such as temperature, water availability, and soil fertility, as well as agronomic practices, further influence these traits. By elucidating the variability in plant height and tiller number, this study aims to inform the development of sustainable rice production systems, enhancing yield stability, resilience to environmental stresses, and resource use efficiency. The study reveals significant variations in rice plant height across seasons and treatments, with consistent averages despite diverse conditions. Investigating the interplay between plant height and tiller numbers, an experiment in the *Kharif* 2021 season showed a negative correlation. This suggests the importance of understanding how plant height influences tillering in rice germplasm lines.

Keywords: Plant height, rice, yield booster, barrier

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops globally, serving as a staple food for over half of the world's population. In rice cultivation, achieving optimal plant height and tiller number is crucial for maximizing yield potential and ensuring agricultural productivity. However, these traits exhibit considerable variability both within and among rice varieties, influenced by genetic, environmental, and management factors (Gulnaz *et al*., 2011) [4].

Understanding the variability in plant height and tiller number is essential for breeders and agronomists seeking to develop high-yielding rice varieties adapted to diverse growing conditions (Das *et al*., 2004) [1]. Plant height influences aspects such as lodging resistance, light interception, and resource allocation, while tiller number directly impacts the potential number of grain-bearing spikes per plant, thereby affecting overall yield (Dere and Yildirim, 2006) [3].

Genetic diversity holds a pivotal role in shaping the spectrum of differences seen in plant height and tiller number across various rice cultivars. By integrating traditional breeding methodologies with cutting-edge genomic tools, there are promising pathways to leverage this genetic variation (Haaning *et al*., 2020) [5]. These avenues empower the development of rice varieties that exhibit tailored plant architectures, precisely suited to distinct agroecological regions and agricultural management strategies (Das *et al*., 2004) [1].

Environmental factors, including temperature, water availability, soil fertility, and photoperiod, also influence plant height and tiller number in rice (Akter *et al*., 2018) [1]. Variations in these environmental conditions across different regions and seasons contribute to the observed phenotypic diversity in rice populations (Dere and Yildirim, 2006) [3].

Furthermore, agronomic practices such as planting density, fertilization, and crop management techniques can impact plant height and tiller number (Haaning *et al*., 2020) [5]. Optimal agronomic strategies need to be tailored to specific rice-growing environments to maximize yield potential while minimizing resource inputs and environmental impacts.

In this context, elucidating the variability in plant height and tiller number in rice is critical for developing sustainable rice production systems that enhance yield stability, resilience to environmental stresses, and resource use efficiency. This study aims to explore the genetic, variability in these essential agronomic traits and their implications for rice breeding and cultivation.

Materials and Methods

i. Selection of seed material

A carefully curated collection of 150 rice accessions (Table S1), each characterized by a complete genome sequence obtained from IRRI, was meticulously chosen according to the criteria delineated by Prabhu *et al.*, 2023 [8]. This meticulously selected set of lines was employed for thorough phenotyping across multiple seasons and exposed to a range of diverse treatments.

ii. Framework of the Experiment

a) Facility/Infrastructure Used

The experiment was conducted by utilising a state-of-the-art high-throughput "Phenomics Facility" developed locally at low cost. This advanced facility is situated at the Department of Crop Physiology, GKVK campus of the University of Agricultural Sciences Bangalor

b) Varied treatments throughout diverse seasons

The phenotyping experiments were executed across various seasons: *Summer* 2020, *Kharif* 2020, and *Kharif* 2021. In the *Summer* 2020 experiment, plants were cultivated under well-watered (WW) conditions, ensuring soil moisture levels were maintained at 100% field capacity (FC) consistently throughout the crop growth cycle. Contrastingly, during the Kharif 2020 experiment, plants experienced water-limited (WL) conditions. Here, soil moisture levels were gradually reduced from 100% FC to 60% FC at the flowering stage and remained at this level until reaching physiological maturity. Similar conditions were replicated in the *Kharif* 2021 experiment, maintaining both well-watered and water-limited conditions.

c) Potting mixture and growth conditions

To maintain consistency and precision in the experiments, two seeds were uniformly sown at a standardized depth in 25 Liters containers filled with a precisely measured potting mixture. This mixture comprised finely sieved red sandy loam soil combined with farmyard manure (FYM) in a 3:1 ratio (v/v). Each container, housing two healthy and uniformly emerged seedlings, was placed on individual load cell balances within the phenomics platform. This setup facilitated continuous monitoring and measurement of water use and various physiological responses exhibited by the plants throughout their growth stages.

The primary aim of these phenotyping experiments was to evaluate the variability in plant height with a consistent number of days to flowering across various seasons and treatments, while also investigating its impact on the total number of tillers.

To achieve this goal, experiments were conducted, and traits were assessed at the stage of physiological maturity.

d) Plant Height: The height of each plant was measured from the base to the tip of the panicle or the longest leaf, expressed in centimetres (cm).

e) Tiller Numbers: The number of tillers per plant was manually counted at the stage of physiological maturity and expressed as the total number of tillers per plant.

f) Statistical Analysis

A completely randomized design (CRD) was used to conduct both experiments. ANNOVA was performed using the SPSS Software to analyse the significant differences among germplasm accessions and between treatments.

Results and Discussion

The study uncovered significant variations in plant height across different seasons and treatments. For instance, in the *Summer* 2020 experiment, plant heights ranged from 63 cm to 189 cm (Figure 1a). Similarly, during the *Kharif* 2020 experiment, heights varied from 56 cm to 168 cm (Figure 1b). When both treatments were applied in the same season, such as during the *Kharif* 2021 experiment, plant heights ranged from 61 cm to 170 cm under well-watered conditions (Figure 1c), and from 56 cm to 163 cm under water-limited conditions (Figure 1d).

Interestingly, despite the different growth conditions and stress levels, the average plant height remained consistent across experiments. Notably, even under water-limited conditions, where stress was imposed during the reproductive stage, there was minimal variation in plant height, as the stress occurred at a stage when plant growth typically peaks (Table 1).

The interplay between plant height and tiller numbers in rice, as examined by Liao *et al.*, 2019 [7], reveals an inverse correlation. However, it's essential to underscore the significant impact of tillering on grain yield, as underscored by Yang *et al.*, 2006 [9], particularly in determining panicle number. Understanding how plant height affects tillering in germplasm lines is paramount. To address this, an experiment was conducted during the Kharif season of 2021, encompassing both well-watered and water-limited treatments. Analysis revealed a negative relationship between tiller number and plant height in both treatments, with respective coefficients of determination (r^2) of 0.308 and 0.284 under well-watered (Figure 2a) and water-limited conditions (Figure 2b). Similarly, Liao *et al*., 2019 [7] elucidated the molecular mechanisms governing the coordinated regulation of plant height and tiller number in rice. Their findings revealed that the rice tiller number regulator MONOCULM 1 (MOC1) is shielded from degradation by binding to the DELLA protein SLENDER RICE 1 (SLR1). Gibberellins (GAs) trigger the degradation of SLR1, promoting stem elongation and subsequently leading to the degradation of MOC1, resulting in a reduction in tiller number. In a study conducted by Yang *et al.*, 2006 [9], negative correlations between tiller number and plant height were observed across five consecutive growth stages. Furthermore, to unravel the genetic underpinnings of the relationship between plant height and tiller number, Kui *et al.*, 2004 [6] employed quantitative trait loci (QTL) mapping using a recombinant inbred population. They identified two-locus interactions for plant height and tiller number at two growth stages over two years. The research highlighted significant negative correlations between tiller number and plant height, shedding light on the genetic basis of this relationship.

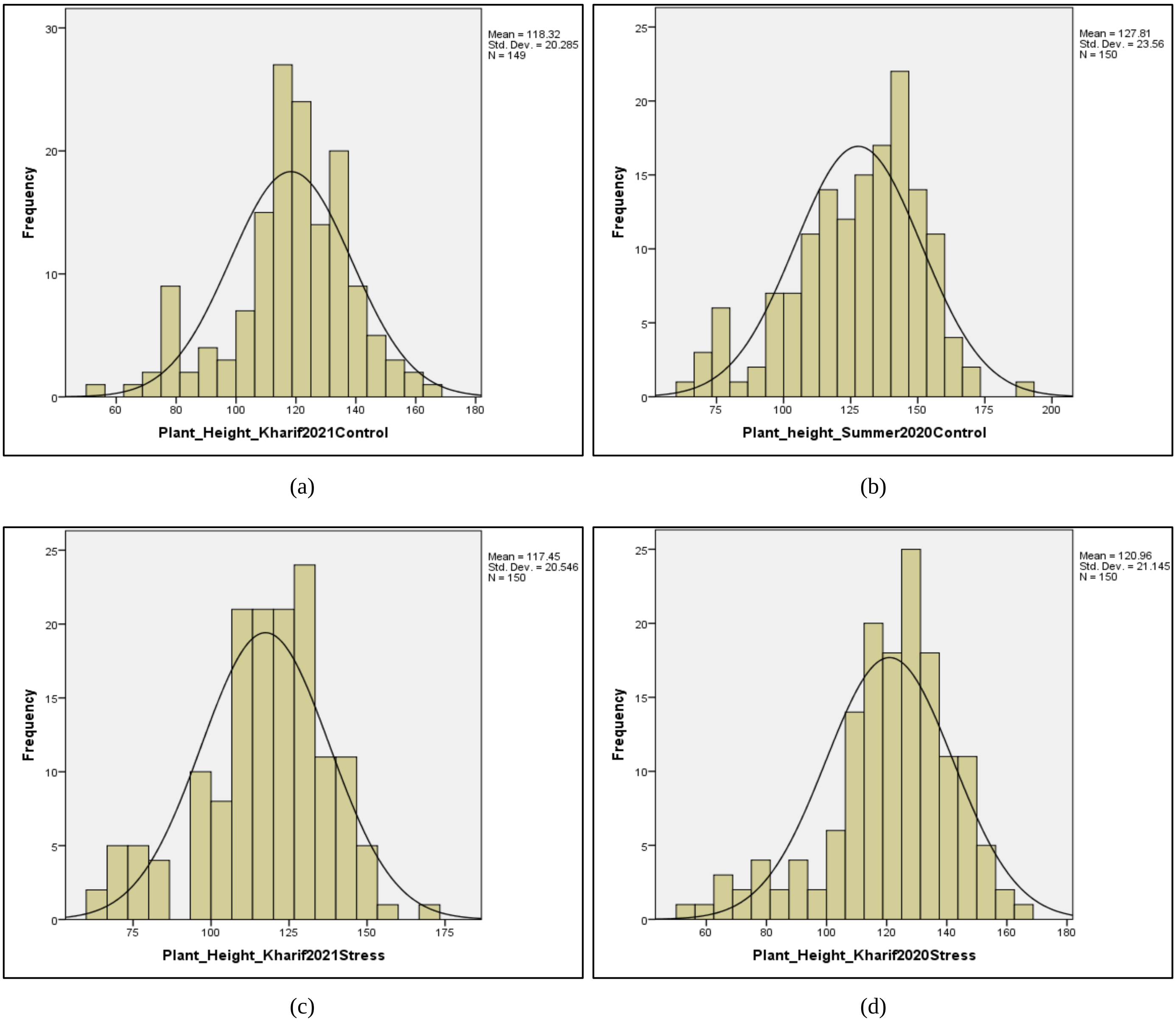

Fig 1: Frequency distribution for the trait Plant height measured during (a) Summer 2020 Well-watered condition, (b) Kharif 2020 under water limited condition, (c) Kharif 2021 well-watered and (d) Kharif 2021 water limited condition

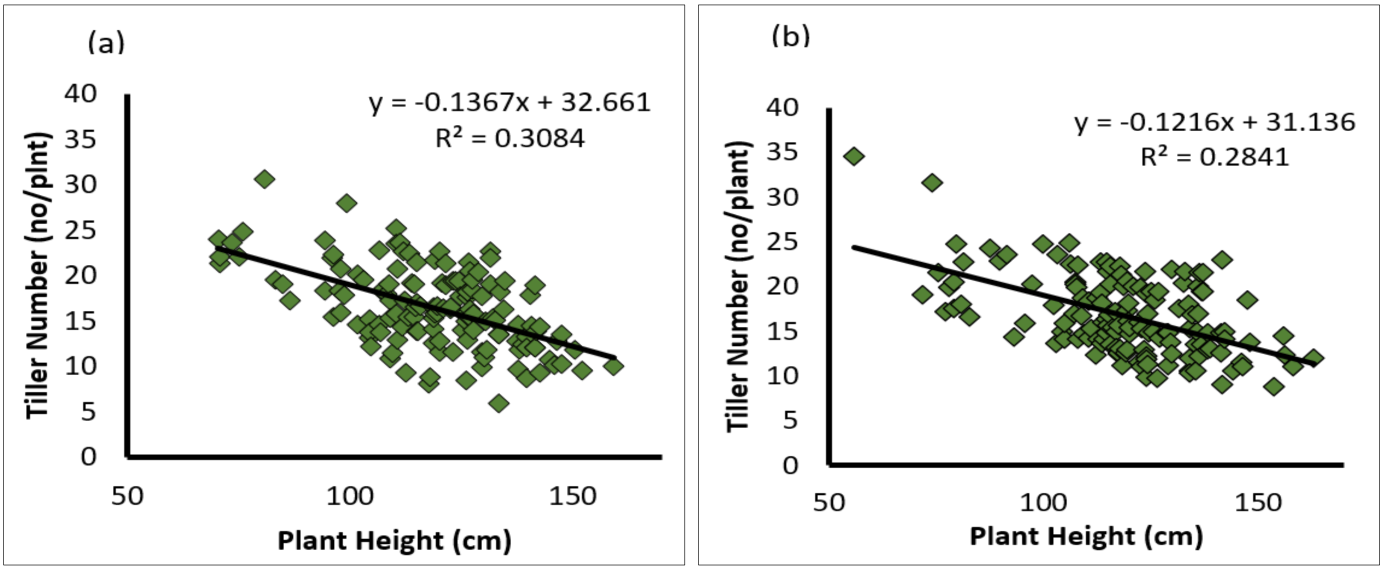

Fig 2: Influence of plant height on till numbers observed during (a) Kharif 2021 well-watered condition and (b) Kharif 2021 water limited condition.

Table 1: Descriptive statistics for the trait Plant Height grown at different seasons and under varied treatments.

Season	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Summer 2020 well-watered	63	189	127.81	1.924	23.560
Kharif 2020 water-limited	56	168	120.96	1.726	21.145
Kharif 2021 well-watered	61	170	117.45	1.678	20.546
Kharif 2021 water-limited	56	163	118.32	1.662	20.285

Supplementary Table 1: Visualization of a cohort comprising 150 distinct rice accessions chosen for phenotypic characterization.

Sl. No	GEN_RIC NO	Accession	Name	Sub population	Country
1	GEN_RIC 013	IRGC 126261	PUILLIPINA KATARI::IRGC 77293-1	ind2	Bangladesh
2	GEN_RIC 014	IRGC 126184	BAZAIL::IRGC 27526-1	indx	India
3	GEN_RIC 021	IRGC 125754	GOJOL GORIA::IRGC 26629-1	ind2	Philippines
4	GEN_RIC 032	IRGC 128327	KABERI::IRGC 66801-1	indx	Burundi
5	GEN_RIC 037	IRGC 127981	BADAL::IRGC 26290-2	ind2	India
6	GEN_RIC 039	IRGC 128064	KALA DIGHA::IRGC 26367-2	ind2	Lao People's Democratic Republic
7	GEN_RIC 052	IRGC 128069	KAL SHULI::IRGC 31665-2	ind2	India
8	GEN_RIC 053	IRGC 132305	BIRUI SAIL::IRGC 31745-2	ind2	India
9	GEN_RIC 055	IRGC 128072	KARTIKHAMA::IRGC 37149-2	indx	Bangladesh
10	GEN_RIC 056	IRGC 128092	KUMRI::IRGC 37182-2	indx	Thailand
11	GEN_RIC 064	IRGC 132308	DUDHSWAR 15-157::IRGC 37967-2	ind2	Sierra Leone
12	GEN_RIC 089	IRGC 127201	BAI MI TIE QIU::IRGC 59414-1	ind1A	India
13	GEN_RIC 090	IRGC 127379	GAO LIANG ZAO::IRGC 59563-1	indx	Madagascar
14	GEN_RIC 106	IRGC 126129	AI ZI HUNG::IRGC 51255-1	ind1A	Myanmar
15	GEN_RIC 122	IRGC 125868	PARA NELLU::IRGC 50009-1	ind2	Bangladesh
16	GEN_RIC 126	IRGC 125853	NCS 237::IRGC 62202-1	ind2	Lao People's Democratic Republic
17	GEN_RIC 127	IRGC 126294	XITTO::IRGC 6671-1	ind2	Cambodia
18	GEN_RIC 129	IRGC 126251	NCS 840::IRGC 62530-1	ind2	Madagascar
19	GEN_RIC 130	IRGC 126008	SURMATIYA::IRGC 74779-1	ind2	India
20	GEN_RIC 131	IRGC 125627	UPRH 233::IRGC 61667-1	ind1A	India
21	GEN_RIC 134	IRGC 131928	ARC 18175::IRGC 42316-1	indx	Philippines
22	GEN_RIC 137	IRGC 126042	ARC 12884::IRGC 22417-1	indx	India
23	GEN_RIC 138	IRGC 126264	RAJHUSAI (ACR 12)::IRGC 53630-1	ind2	India
24	GEN_RIC 142	IRGC 126011	TYPE 50::IRGC 74782-1	ind2	India
25	GEN_RIC 143	IRGC 126000	NIRGUNI::IRGC 61127-1	ind2	Burundi
26	GEN_RIC 145	IRGC 125648	ARC 14060::IRGC 41374-1	ind2	Viet Nam
27	GEN_RIC 147	IRGC 125869	PATALASAFED SUNGHAWADO::IRGC 61133-1	ind2	India
28	GEN_RIC 148	IRGC 125815	KUTTA::IRGC 52184-1	ind2	India
29	GEN_RIC 153	IRGC 125655	ARC 18112::IRGC 42274-1	indx	India
30	GEN_RIC 154	IRGC 125637	ARC 10754::IRGC 12603-1	indx	Nepal
31	GEN_RIC 156	IRGC 125649	ARC 14064::IRGC 41377-1	indx	India
32	GEN_RIC 161	IRGC 126158	MAKRO::IRGC 74763-1	ind2	India
33	GEN_RIC 162	IRGC 126150	G 25::IRGC 45733-1	ind2	Brazil
34	GEN_RIC 164	IRGC 125647	ARC 13778::IRGC 41216-1	indx	Thailand
35	GEN_RIC 171	IRGC 125845	MULLIKURUVA::IRGC 77529-1	ind2	Nepal
36	GEN_RIC 175	IRGC 125890	RPA 5929 (K 45)::IRGC 33963-1	indx	India
37	GEN_RIC 176	IRGC 125636	ARC 10594::IRGC 12524-1	indx	India
38	GEN_RIC 180	IRGC 126175	ARC 18202::IRGC 42328-1	indx	Indonesia
39	GEN_RIC 184	IRGC 126280	T 315::IRGC 54792-1	ind2	Madagascar
40	GEN_RIC 187	IRGC 122181	NONA BOKRA::IRGC 22710-C1	ind2	Philippines
41	GEN_RIC 191	IRGC 127647	NAPDAI::IRGC 52009-1	ind2	India
42	GEN_RIC 193	IRGC 127209	BARAMANJ::IRGC 52067-1	ind2	Bangladesh
43	GEN_RIC 208	IRGC 127160	ARC 15480::IRGC 53799-1	indx	Colombia
44	GEN_RIC 209	IRGC 127230	BIR BAHADUR::IRGC 53889-1	ind2	India
45	GEN_RIC 226	IRGC 127877	UPRH 265::IRGC 61689-1	indx	India
46	GEN_RIC 229	IRGC 127657	NCS 349::IRGC 62257-1	indx	Bangladesh
47	GEN_RIC 230	IRGC 127658	NCS 458::IRGC 62290-1	ind2	Kenya
48	GEN_RIC 235	IRGC 127665	NCS 771 A::IRGC 62483-1	ind2	Indonesia
49	GEN_RIC 236	IRGC 127667	NCS 830::IRGC 62518-1	ind2	Lao People's Democratic Republic
50	GEN_RIC 242	IRGC 127096	19::IRGC 70786-1	ind2	Sri Lanka
51	GEN_RIC 246	IRGC 127544	LALI GURMATIA::IRGC 70854-1	ind2	India
52	GEN_RIC 250	IRGC 127535	KUNJUKUNJU::IRGC 75448-1	indx	Gambia
53	GEN_RIC 259	IRGC 127107	ADT 12::IRGC 6254-1	ind2	India
54	GEN_RIC 263	IRGC 127163	ARC 6052::IRGC 12196-1	ind2	India
55	GEN_RIC 265	IRGC 127168	ARC 7236::IRGC 12335-1	ind2	India
56	GEN_RIC 268	IRGC 127128	ARC 10581::IRGC 12514-1	indx	Myanmar
57	GEN_RIC 270	IRGC 127932	ARC 10846::IRGC 12656-2	indx	India
58	GEN_RIC 271	IRGC 127132	ARC 10905::IRGC 12669-1	indx	India

59	GEN_RIC 273	IRGC 128081	KH 998::IRGC 16948-2	indx	Bangladesh
60	GEN_RIC 280	IRGC 127972	ARC 6015::IRGC 20314-2	indx	India
61	GEN_RIC 289	IRGC 127131	ARC 10894::IRGC 21122-1	indx	India
62	GEN_RIC 306	IRGC 127940	ARC 12180::IRGC 21965-2	ind2	Indonesia
63	GEN_RIC 318	IRGC 128090	KOLONGI BAO::IRGC 24135-2	ind2	Thailand
64	GEN_RIC 321	IRGC 128046	GUTTI AKKULLU::IRGC 26850-2	ind2	Madagascar
65	GEN_RIC 342	IRGC 128020	CR 157-392-4::IRGC 39247-2	indx	India
66	GEN_RIC 343	IRGC 128121	OR 117-8::IRGC 39680-2	ind2	India
67	GEN_RIC 346	IRGC 127167	ARC 7056::IRGC 40914-1	indx	India
68	GEN_RIC 348	IRGC 127944	ARC 12757::IRGC 41095-2	indx	Sri Lanka
69	GEN_RIC 350	IRGC 127950	ARC 13591::IRGC 41177-2	indx	Lao People's Democratic Republic
70	GEN_RIC 351	IRGC 127951	ARC 13785::IRGC 41218-2	indx	Madagascar
71	GEN_RIC 352	IRGC 127952	ARC 13888::IRGC 41288-2	indx	Burundi
72	GEN_RIC 353	IRGC 127953	ARC 13919::IRGC 41313-2	indx	India
73	GEN_RIC 354	IRGC 132241	ARC 13934::IRGC 41325-2	indx	China
74	GEN_RIC 356	IRGC 127955	ARC 14347::IRGC 41517-2	indx	Nepal
75	GEN_RIC 358	IRGC 132319	ARC 15063::IRGC 41909-2	indx	Bangladesh
76	GEN_RIC 360	IRGC 131967	ARC 15505::IRGC 42066-1	ind1A	Bangladesh
77	GEN_RIC 362	IRGC 132320	ARC 15743::IRGC 42127-2	indx	India
78	GEN_RIC 365	IRGC 127969	ARC 18371::IRGC 42423-2	indx	Sierra Leone
79	GEN_RIC 368	IRGC 127929	ARC 10120::IRGC 42557-2	indx	India
80	GEN_RIC 370	IRGC 127936	ARC 11245::IRGC 42651-2	ind2	Taiwan
81	GEN_RIC 373	IRGC 127945	ARC 12800::IRGC 42720-2	indx	India
82	GEN_RIC 375	IRGC 127960	ARC 14709::IRGC 42976-2	ind2	India
83	GEN_RIC 376	IRGC 127963	ARC 14868::IRGC 43009-2	ind2	Philippines
84	GEN_RIC 379	IRGC 127158	ARC 15163::IRGC 43106-1	indx	India
85	GEN_RIC 380	IRGC 127964	ARC 15373::IRGC 43166-2	indx	Bangladesh
86	GEN_RIC 381	IRGC 127159	ARC 15385::IRGC 43174-1	indx	India
87	GEN_RIC 382	IRGC 127965	ARC 15387::IRGC 43175-2	indx	India
88	GEN_RIC 383	IRGC 127966	ARC 15403::IRGC 43183-2	ind2	China
89	GEN_RIC 384	IRGC 128229	ARC 15862::IRGC 43242-1	indx	Myanmar
90	GEN_RIC 385	IRGC 127968	ARC 15929::IRGC 43269-2	ind2	India
91	GEN_RIC 401	IRGC 128095	LANJALI::IRGC 46236-2	indx	Nepal
92	GEN_RIC 404	IRGC 128146	RANACHANDRABHOG::IRGC 46567-2	ind2	India
93	GEN_RIC 414	IRGC 127495	KARUNJEERAGA SAMBA::IRGC 49774-1	indx	Indonesia
94	GEN_RIC 415	IRGC 127529	KONAMANI::IRGC 49806-1	ind2	India
95	GEN_RIC 418	IRGC 128138	PISINI::IRGC 50035-2	ind2	Bangladesh
96	GEN_RIC 421	IRGC 120921	CSR-90 IR-2::IRGC 117327-1	indx	India
97	GEN_RIC 424	IRGC 125852	NCS 194::IRGC 51932-1	ind1A	India
98	GEN_RIC 432	IRGC 125668	BAIANG 6::IRGC 6129-1	indx	Madagascar
99	GEN_RIC 446	IRGC 127196	B 3913 B 16-20 ST 28::IRGC 63099-1	indx	Cuba
100	GEN_RIC 447	IRGC 127740	PORONG::IRGC 76983-1	ind1B	Fiji
101	GEN_RIC 459	IRGC 132357	NARUN::IRGC 18320-2	ind3	India
102	GEN_RIC 469	IRGC 126083	ROJOFOTSY::IRGC 69402-1	ind2	Bangladesh
103	GEN_RIC 473	IRGC 131972	BORIZINA 640::IRGC 68382-1	ind3	India
104	GEN_RIC 478	IRGC 127885	VARY LAHY::IRGC 69908-1	ind2	Viet Nam
105	GEN_RIC 493	IRGC 127979	BAANYALOJOPOIHUN::IRGC 7928-2	ind2	Bangladesh
106	GEN_RIC 494	IRGC 121154	WAR 72-2-1-1::IRGC 117361-1	indx	Guatemala
107	GEN_RIC 500	IRGC 127632	MOSHI::IRGC 70648-1	ind2	India
108	GEN_RIC 504	IRGC 131988	GNASSOUMADOUGOU::IRGC 75595-1	indx	Taiwan
109	GEN_RIC 505	IRGC 127484	KAMPTI::IRGC 75626-1	ind3	India
110	GEN_RIC 514	IRGC 127872	UGAGA::IRGC 67604-1	indx	India
111	GEN_RIC 520	IRGC 127319	DIAMBARANG::IRGC 56726-1	ind3	India
112	GEN_RIC 530	IRGC 125773	IR 13429-109-2-2-1::IRGC 63491-1	indx	India
113	GEN_RIC 538	IRGC 122088	IR 1561-228-3-3::IRGC 32627-C1	indx	Bhutan
114	GEN_RIC 556	IRGC 127434	IR 19058-107-1::IRGC 72997-1	ind1B	Nepal
115	GEN_RIC 569	IRGC 126258	PAH WEAN::IRGC 78276-1	ind3	India
116	GEN_RIC 570	IRGC 125965	HAWM KRUA::IRGC 64333-1	ind3	India
117	GEN_RIC 571	IRGC 126216	JAO LEUANG::IRGC 65866-1	ind3	India
118	GEN_RIC 574	IRGC 126132	E DAW HAWM::IRGC 47938-1	ind3	India
119	GEN_RIC 581	IRGC 126003	RD 15::IRGC 47705-1	ind3	India
120	GEN_RIC 626	IRGC 127576	LOUK PASOM::IRGC 98136-1	indx	India
121	GEN_RIC 652	IRGC 127850	TAUNG LWIN::IRGC 58222-1	indx	India
122	GEN_RIC 664	IRGC 128183	THAKADE THEEDAT::IRGC 33772-2	ind3	Burkina Faso
123	GEN_RIC 698	IRGC 127975	ARITH::IRGC 84347-2	ind3	India
124	GEN_RIC 699	IRGC 127177	ATT CHHMOUS::IRGC 87030-1	ind3	Brazil
125	GEN_RIC 701	IRGC 127121	AM BEUS::IRGC 87189-1	indx	India
126	GEN_RIC 702	IRGC 127171	ARNG'-KAR PHAR ONG::IRGC 87196-1	ind3	Cambodia

127	GEN_RIC 704	IRGC 132279	DAMNOEUB KRACHAK SESS::IRGC 87380-1	ind3	India
128	GEN_RIC 711	IRGC 125955	BW 295-5::IRGC 63098-1	ind1B	Guinea-Bissau
129	GEN_RIC 712	IRGC 125813	KURULUTUDU::IRGC 36304-1	ind2	India
130	GEN_RIC 721	IRGC 127227	BIJULI BATI::IRGC 58917-1	ind2	China
131	GEN_RIC 722	IRGC 125749	GARURA::IRGC 64111-1	indx	Indonesia
132	GEN_RIC 736	IRGC 127425	I 41::IRGC 75927-1	ind1A	United States of America
133	GEN_RIC 740	IRGC 127212	BARKHE TAULI::IRGC 16116-1	ind1A	Lao People's Democratic Republic
134	GEN_RIC 750	IRGC 125840	MILYANG 77::IRGC 69340-1	ind1B	Madagascar
135	GEN_RIC 751	IRGC 125906	SSANGDUJO::IRGC 55632-1	ind1A	Madagascar
136	GEN_RIC 771	IRGC 128368	LOC TRANG MUON::IRGC 73216-1	indx	Bangladesh
137	GEN_RIC 773	IRGC 128098	LUA HUONG T 1::IRGC 7082-2	ind3	India
138	GEN_RIC 774	IRGC 127578	LUA DUC::IRGC 16718-1	indx	India
139	GEN_RIC 775	IRGC 128186	TIEN SOM::IRGC 40759-2	ind3	India
140	GEN_RIC 782	IRGC 125913	TAIPEI WOO CO::IRGC 112-1	ind1A	Tanzania
141	GEN_RIC 783	IRGC 125928	TSAI YUAN CHON::IRGC 126-1	ind1A	India
142	GEN_RIC 784	IRGC 125770	I KUNG PAO::IRGC 114-1	ind1A	Korea, Republic of
143	GEN_RIC 786	IRGC 127278	CHING CH'UNG::IRGC 65002-1	indx	India
144	GEN_RIC 790	IRGC 125658	ASU::IRGC 62154-1	indx	Madagascar
145	GEN_RIC 812	IRGC 121342	GEANT W 7::IRGC 9620-1	ind2	Philippines
146	GEN_RIC 823	IRGC 128205	ZACATEPEC::IRGC 16901-2	ind1B	Madagascar
147	GEN_RIC 832	IRGC 126064	IRGA 959-1-2-2F-4-1-4A-6-CA-6X::IRGC 117006-1	indx	Viet Nam
148	GEN_RIC 836	IRGC 125989	IRGA 370-42-1-1F-C-1::IRGC 117343-1	ind1B	India
149	GEN_RIC 845	IRGC 125739	FACAGRO 64::IRGC 82059-1	ind2	India
150	GEN_RIC 851	IRGC 125818	LALKA (LAL DHAN)::IRGC 64946-1	ind2	Viet Nam

Conclusion

The meticulous examination conducted across diverse seasons and treatment regimens unveiled substantial fluctuations in plant height, exemplifying the adaptive responses of rice plants to varying environmental stimuli. Despite the fluctuating conditions, the average plant height exhibited remarkable consistency across experimental iterations, underscoring the resilience of rice growth dynamics, even in the face of stressors.

The identified negative correlation between plant height and tiller numbers echoes the findings of prior research, accentuating the nuanced interaction between these pivotal traits within the rice ecosystem. This intricate relationship emphasizes the critical role of tillering in shaping grain yield, a fact well-established in agricultural literature. Moreover, the strategic selection of genotypes favouring semi dwarf varieties not only augments tiller count but also optimizes leaf exposure to sunlight, thereby enhancing photosynthetic efficiency and contributing to increased productivity. This underscores the multifaceted benefits of cultivar selection strategies geared towards enhancing both tiller production and light interception, ultimately culminating in elevated agricultural output.

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