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Growth and physiological performance of primed rice genotypes under pot culture

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Abstract

The present investigation was carried out at green house, department of crop physiology, S.V Agricultural College, Tirupati to know the effect of seed priming on growth and physiological parameters of dry direct sown rice (*Oryza sativa* L.) under pot culture. The experiment was conducted in completely randomized design with 20 combinations (4 varieties and 5 treatments). Varieties screened are MTU 1010, JGL 20171, NLR33671 and MTU 1112, whereas treatments are Control (Hydropriming/Water soaking), 1000 PPM GA₃ and combination of both gibberillic acid and KNO₃ treatments i.e.; GA₃ (200PPM, 500PPM, 1000PPM + KNO₃@3%), in order to know the effect of growth and physiological performance of seed primed rice genotypes under pot culture. Various physiological observations like plant height, No of leaves, Leaf area, Total dry matter, Days to 50% flowering and Yield attributes was measured in all four genotypes.

Keywords: Gibberillic acid, KNO₃, seed priming

Introduction

Rice (*Oryza sativa* L.) is the most important cereal food crop of the developing world and the staple food of more than half of the world's population. Rice crop plays a pivotal role in our national food security and serves as a source of livelihood for millions of rural households. Globally rice is grown over an area of 162.05 million ha with an annual production of 755.4 million tonnes (FAOSTAT). Irrigated rice is the major consumer of fresh water. Of late water has become the most crucial resource for agriculture especially in Asia and becoming increasingly scarce due to competition from domestic and industrial requirement. It was estimated that by 2025, about 15-20 million hectares of irrigated rice will be affected due to water scarcity which threatens the productivity. Combining the growing demand for food with increasing water scarcity, rice producers in Asia need to produce more rice with less water.

Therefore, a major challenge in rice production is to save water while maintaining or even increasing the grain yield (Yang and Zhang, 2010) [20]. Many water-saving technologies are currently used in rice production, including alternate wetting and drying irrigation, the rice intensification system, aerobic rice and the ground cover rice production systems (GCRPSs) (Qin *et al.*, 2006) [14]. Among these aerobic rice is gaining popularity as a strategy for water saving agriculture.

Aerobic rice can achieve yields of 4-6 tons per hectare with 50 - 70% less water compared to lowland rice it does not require flooded wetland (Qin *et al.*, 2010) [14]. In aerobic rice production, the seeds are direct-seeded in aerobic soil without any standing water layer, which minimizes water use and boosts up water productivity by eliminating continuous seepage and percolation, reducing evaporation and eliminating wetland preparation (Nie *et al.*, 2012; Singh *et al.*, 2008) [13, 17]. Season-long weed infestation in aerobic rice may cause yield reduction up to 80% or complete failure of crop in extreme cases (Jayadeva *et al.*, 2011; Sunil *et al.*, 2010) [9, 18].

Therefore, the aerobic rice cultivars should have the capacity of early seedling establishment, quick crop growth and yield stability. Identification of strong weed competitive rice cultivar is a feasible solution to inhibit the growth of weeds and it is a cost-effective and safe tool for weed management (Zhao *et al.*, 2006) [21]. Seedling vigour is a physiological trait and a sign of potential seed germination, seedling growth and tolerance to adverse climatic factors. On the other hand,

it significantly improves the speed, uniformity and the final percentage of germination, and leads to ideal field appearance with good potential grain yield under direct-seeded conditions (Foolad *et al.*, 2007)^[6].

Thus, to suppress weed growth, early seedling vigour of an elite variety should be achieved. Seed priming is a viable option to attain this target. Seed priming, which is also called seed hardening, is a physiological seed enhancement method. It is a pre-sowing treatment in which seeds are soaked in an osmotic solution that allows them to imbibe water and go through the first stages of germination, but does not permit radicle protrusion through the seed coat. Subsequently, the seeds can be dried to attain their original moisture content and stored or planted using conventional techniques.

Materials and Methods

Preparation of treatment combinations of GA₃ and KNO₃.

0.1, 0.25 and 0.5 g each of GA₃ (gibberellic acid, HIMEDIA) was dissolved separately 500 ml each in DDW along with 1.5 g KNO₃ in each case to prepare a series of solutions that gives GA₃ @ 200 ppm + KNO₃ @ 3%, GA₃ @ 500 ppm + KNO₃ @ 3%, GA₃ @ 1000 ppm + KNO₃ @ 3%, whereas for control treatment seed were soaked in water (Hydropriming), 0.5 g of GA₃ was dissolved in 500 mL of DDW to get GA₃ @ 1000 ppm.

Standard crop husbandry measures in terms of nutrition, irrigation and plant protection measures were followed. Altogether there were 20 combinations in this experiment (4 varieties and 5 Treatments). Each combination was sown in seven pots. There were 6 plants accommodated in each pot by taking care of spacing requirement. Three plants were collected from each pot at each stage for destructive analysis. Each pot was considered as one replication.

Results and Discussion

Plant height (cm)

Plant height was recorded at 15 days interval from 15 days after sowing till 90 DAS and presented in Table 1. The data revealed a continuous increase in plant height from 15 DAS till 90 DAS.

Among varieties MTU 1010 (17.34, 33.38, 45.61, 55.34, 62.51 and 71.64) recorded significantly highest plant height at all the crop growth stages *viz*; 15, 30, 45, 60, 75, and 90 DAS followed by JGL 20171 expect at 15 and 90 DAS, whereas MTU 1112 recorded significantly lowest plant height (14.38, 23.83, 32.46, 42.25, 53.51 and 69.11) at corresponding growth stages. Thus the results of laboratory test was confirmed in pot culture. The initial early vigour of MTU 1010 and JGL 20171 compared to MTU 1112 was very clear.

The effect of treatment on plant height was also observed to be significant. T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (19.77, 33.46, 45.45, 54.32, 63.92 and 72.88) recorded significantly highest plant height at all the stages of crop growth stages. At 90 DAS T₁ (Control) (68.90) recorded significantly lowest and at par value with T₅ (GA₃ @ 1000 ppm + KNO₃ @ 3%) (69.70). Interaction effect among varieties and treatments was found to be significant at all the stages except at 30 DAS.

At 15 and 90 DAS V₃T₄ (20.23 and 74.36) recorded significantly highest plant height whereas V₄T₁ (9.5 and 66.86) was observed to record significantly lowest plant height.

The positive influence of seed priming with GA₃ and KNO₃ on plant height also reported by Rood *et al.*, 1990^[15]; Helms *et al.*, 1990^[7]; Bevilacqua, 1996^[2] and Kumar *et al.*, 2015^[10].

Leaf area (cm²)

Leaf area of a plant represents its source size. Higher functional leaf area is an essential prerequisite for better yield.

The data on effect of seed priming treatments and varieties on leaf area was presented in table 2.

Leaf area was found to increase gradually from 15 DAS to 90 DAS. However between 30 to 45 days as well as 75 to 90 days of the crop duration the increase was observed to be higher.

Among varieties MTU 1010 (14.29, 30.49, 177.77, 343.54, 501.14 and 802.78) recorded significantly highest leaf area followed by JGL 20171 and NLR 33671, whereas MTU 1112 (11.93, 27.41, 161.98, 289.7, 457.99 and 692.09) recorded significantly lowest leaf area at all the crop growth stages. The initial advantage of 19.78 and 11.2 percent was observed in MTU 1010 over MTU 1112 at 15 and 30 DAS.

Significant differences among the treatments was observed with respect to leaf area. T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (15.01, 31.92, 176.49, 364.26, 548.28 and 848.15) recorded significantly highest leaf area and T₁ (Control) (12.78, 26.19, 162.05, 281.54, 429.1 and 742.6) recorded significant lowest leaf area at all the crop growth stages. An initial increase of 17.4 and 21.8 percent was observed in T₄ over T₁.

MTU 1112 was considered as a low vigour check variety. However it also responded well to different priming treatments. At 90 DAS leaf area with T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) in this genotype was 848.15 where as it was as low only 782.16 with T₁ (control). It explains the positive role of GA₃ on increased metabolism of the plant in the initial stages compared to hydropriming.

Variety and treatment interaction was observed to be significant at all the growth stages. At 90 DAS highest leaf area was recorded with V₁ T₄ (867.8) whereas lowest was observed in V₄ T₁ (645.6). Such preliminary advantage of canopy development with priming treatment was also reported by Rood *et al.*, 1990^[15] and Anwar *et al.*, 2012^[1].

Total dry matter (g)

Total dry matter signifies the accumulation of photosynthates and their conversion in to plant biomass. Data on effect of seed priming treatments and varieties on total dry matter was presented in table 3. Total dry matter of the plant was observed to be increased with time.

Among different varieties MTU 1010 (0.98, 2.06, 4.96, 10.32, 15.74 and 24.3) recorded significantly highest total dry matter at 15, 30, 45, 60, 75 and 90 DAS respectively. However JGL 20171 (2.0, 5.18 and 9.58) and NLR 33671 (1.94, 4.90 and 10.28) were observed to be at par with MTU 1010 at 30, 45 and 60 DAS. Thus compared to the lowest check (MTU 1112) all the varieties were observed to possess more or less same total dry matter content.

Influence of T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (108, 25, 6.08, 11.42, 17.03 and 26.45) observed to be significantly higher among different varieties at different crop growth stages. Whereas T₁ (Control) (0.75, 1.52, 3.73, 7.95, 12.48 and 18.73) recorded significantly lowest total dry matter at the same periods of crop growth. It signifies the advantage of GA₃ priming over hydropriming.

The interaction effect was observed to be significant between varieties and treatments. V₁T₄ (1.2, 6.4, 12.3 and 28.9) recorded significantly highest total dry matter at 15, 45, 60 and 90 DAS, whereas the lowest values were recorded in V₄T₁ (1.3 and 18.0) at 30 and 90 DAS. The results clearly explained the positive effect of variety MTU 1010, treatment T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) and their interaction over other varieties and treatments. Similar results were also suggested by Tilahun *et al.*, 2007^[19] and Namuco *et al.*, 2009^[12].

Days to 50% flowering

Data on days to 50% flowering was recorded from the rice genotypes grown on pot culture and presented in table 4. The initial vigour of the seedling and accumulation of more dry matter at the initial stages of the crop might lead to shift the plant from vegetative to reproductive phase. The data revealed a significant difference among genotypes with respect to days to 50% flowering.

The genotypes MTU 1010 (76.4) recorded significantly early flowering followed by JGL 20171 (77.8) and NLR 33671 (93.6) whereas the genotype MTU 1112 (102.2) recorded a delay in flowering. Among the treatments T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (84.75) promoted early flowering followed by T₂ (GA₃ @ 1000 ppm) (86.75). However, the interaction effect was observed to be non-significant. Sanders *et al.*, 2000 [16] also reported a similar accelerated maturity with seed priming.

Yield and yield attributes**Number of productive tillers per plant**

The data on Yield and yield attributes was presented in table 4. The data revealed a significantly higher number of Productive tillers with variety MTU 1010 (7.0) and treatment T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (8.75). The interaction effect was observed to be significant and the highest number of productive tillers were recorded in V₁T₄ (10.0) whereas the lowest was observed with V₂T₂ (4.0).

Such an increased number of productive tillers with seed

priming was also suggested by Mahajan *et al.*, 2011 [11].

Grains per panicle

MTU 1010 genotype recorded significantly, highest number of grains (161.28) followed by JGL 20171 (154.22), NLR 33671 (144.84) whereas MTU 1112 recorded lowest values (133.59). Among the treatments T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (204.95) recorded significantly highest value.

The interaction effect was found to be significant and was highest with V₁T₄ (231.4). Similar results were also reported by Farooq *et al.*, 2008 [4,5].

Test weight

1000 grain weight is an important yield attribute which signifies translocation of photo-assimilates in to the reproductive sinks. The data revealed that highest 1000 grain weight was observed with MTU 1010 (19.82) followed by JGL 20171 (19.64) and NLR 3367 (18.33) whereas the genotype MTU 1112 recorded significantly lowest value (18.23).

Among treatment T₄ (GA₃ @ 500 ppm + KNO₃ @ 3%) (21.0), T₅ (GA₃ @ 1000 ppm + KNO₃ @ 3%) (19.85) and T₃ (GA₃ @ 200 ppm + KNO₃ @ 3%) (19.57) recorded highest and significantly at par values. The lowest value were recorded with T₁ (control) (16.72) which was at par with T₂ (GA₃ @ 1000 ppm) (18.12).

Further it was observed that V₁T₄ (22.4) recorded significantly highest interaction effect with respect to 1000 grain weight.

Table 1: Influence of different seed priming treatments and varieties on plant height (cm) at different crop growth stages under pot culture

Variety	15 DAS					Mean	30 DAS					Mean	45 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	16.00	17.53	19.33	20.07	13.80	17.35	31.33	34.60	32.50	38.47	30.00	33.38	44.37	45.40	45.33	48.30	44.67	45.61
JGL 20171	14.77	15.23	13.50	19.97	15.20	15.73	26.70	33.33	32.17	33.67	25.03	30.18	44.20	46.97	43.00	48.33	42.27	44.95
NLR 33671	14.27	18.33	15.87	20.23	12.37	16.21	28.50	31.00	29.50	33.90	25.40	29.66	43.50	40.83	42.40	46.87	38.63	42.45
MTU 1112	9.50	14.97	14.00	18.83	14.63	14.39	23.17	23.70	25.43	27.83	19.00	23.83	34.70	32.70	30.93	38.30	25.70	32.47
Mean	13.63	16.52	15.68	19.78	14.00		27.43	30.66	29.90	33.47	24.86		41.69	41.48	40.42	45.45	37.82	
		V	T	V × T				V	T	V × T				V	T	V × T		
C.D		1.23	1.37	2.74				1.83	2.04	NS				1.44	1.61	3.23		
SE(D)		0.60	0.68	1.35				0.90	1.01	2.01				0.71	0.80	1.59		
SE(M)		0.43	0.48	0.96				0.64	0.71	1.42				0.50	0.56	1.13		

Variety	60 DAS					Mean	75 DAS					Mean	90 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	54.37	58.73	53.63	56.23	53.77	55.35	59.17	63.17	63.33	68.17	58.73	62.51	70.10	71.40	72.37	73.17	71.17	71.64
JGL 20171	53.50	57.33	50.50	57.17	54.33	54.57	61.33	64.77	63.80	68.17	59.83	63.58	68.50	71.50	71.37	71.83	69.50	70.54
NLR 33671	51.50	52.77	52.37	55.63	49.53	52.36	60.50	64.00	60.10	64.20	59.10	61.58	70.17	70.33	72.07	74.37	69.17	71.22
MTU 1112	38.67	44.33	45.00	48.27	35.00	42.25	54.23	50.30	55.00	55.17	52.83	53.51	66.87	70.80	66.73	72.17	69.00	69.11
Mean	49.51	53.29	50.38	54.33	48.16		58.81	60.56	60.56	63.93	57.63		68.91	71.01	70.63	72.88	69.71	
		V	T	V × T				V	T	V × T				V	T	V × T		
C.D		1.38	1.54	3.09				1.13	1.26	2.52				0.98	1.10	2.20		
SE(D)		0.68	0.76	1.52				0.56	0.62	1.24				0.49	0.54	1.09		
SE(M)		0.48	0.54	1.08				0.39	0.44	0.88				0.34	0.38	0.77		

T₁: Control; T₂: GA₃ @ 1000 ppm; T₃: GA₃ @ 200 ppm + KNO₃ @ 3%; T₄: GA₃ @ 500 ppm + KNO₃ @ 3%; T₅: GA₃ @ 1000 ppm + KNO₃ @ 3%

Table 2: Influence of different seed priming treatments and varieties on leaf area (cm² plant⁻¹) at different crop growth stages under pot culture

Variety	15 DAS					Mean	30 DAS					Mean	45 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	13.52	14.50	15.50	16.40	11.57	14.30	25.67	28.90	32.34	34.60	30.98	30.50	165.78	176.80	180.90	185.60	179.80	177.78
JGL 20171	13.57	14.13	14.53	15.43	10.87	13.71	25.70	24.35	32.70	30.90	28.90	28.51	164.56	174.30	172.40	176.78	170.98	171.80
NLR 33671	12.50	13.73	13.80	14.70	10.03	12.95	28.90	29.80	26.78	32.40	30.20	29.62	158.90	167.89	172.40	177.89	169.80	169.38
MTU 1112	11.57	12.19	12.35	13.53	10.03	11.93	24.50	28.90	26.00	29.80	27.89	27.42	158.98	162.34	163.00	165.70	159.90	161.98
Mean	12.79	13.64	14.05	15.02	10.62		26.19	27.99	29.46	31.93	29.49		162.06	170.33	172.18	176.49	170.12	
		V	T	V × T				V	T	V × T				V	T	V × T		
C.D		0.13	0.14	0.29				1.54	2.61	2.10				2.10	2.60	1.78		
SE(D)		0.06	0.07	0.14				1.15	1.29	2.58				6.79	7.59	15.19		
SE(M)		0.05	0.05	0.10				0.81	0.91	1.82				4.80	5.37	10.74		

Variety	60 DAS					Mean	75 DAS					Mean	90 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	298.80	320.90	345.60	386.70	365.70	343.54	436.70	456.80	487.90	589.70	534.60	501.14	765.70	789.60	800.90	867.80	789.90	802.78
JGL 20171	250.78	267.80	324.50	367.90	300.90	302.38	434.70	529.80	498.70	500.98	432.10	479.26	735.60	802.45	798.78	823.45	810.98	794.25
NLR 33671	298.70	300.80	310.90	356.78	289.00	311.24	423.70	400.98	523.45	567.80	456.70	474.53	723.50	756.80	823.50	857.80	798.90	792.10
MTU 1112	277.89	234.67	289.70	345.67	300.60	289.71	421.30	400.90	432.10	534.67	500.98	457.99	645.60	669.80	700.70	743.56	690.80	692.09
Mean	281.54	281.04	317.68	364.26	314.05		429.10	447.12	485.54	548.29	481.10		742.60	782.16	805.97	848.15	797.65	
		V	T	V × T				V	T	V × T			V	T	V × T			
C.D		25.17	28.15	20.30				38.40	42.35	84.70			20.30	31.54	22.30			
SE(D)		12.41	13.88	27.75				18.67	20.88	41.75			23.40	35.26	24.93			
SE(M)		8.78	9.81	19.62				13.20	14.76	29.52			17.80	70.52	49.87			

T₁: Control; T₂: GA₃ @ 1000 ppm; T₃: GA₃ @ 200 ppm + KNO₃ @ 3%; T₄: GA₃ @ 500 ppm + KNO₃ @ 3%; T₅: GA₃ @ 1000 ppm + KNO₃ @ 3%

Table 3: Influence of different seed priming treatments and varieties on total dry matter (g) at different crop growth stages under pot culture

Variety	15 DAS					Mean	30 DAS					Mean	45 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	0.80	1.00	0.90	1.20	1.00	0.98	1.40	1.90	2.30	2.70	2.00	2.06	4.00	4.60	4.80	6.40	5.00	4.96
JGL 20171	0.60	1.00	0.90	1.00	0.70	0.84	1.80	1.90	1.50	2.80	2.00	2.00	3.90	5.40	4.80	6.20	5.60	5.18
NLR 33671	0.70	0.90	1.00	1.10	0.98	0.94	1.60	2.00	1.80	2.30	2.00	1.94	3.80	4.90	5.10	6.00	4.70	4.90
MTU 1112	0.90	0.80	0.70	1.00	1.00	0.88	1.30	1.50	2.00	2.20	1.70	1.74	3.20	4.20	5.80	5.70	4.30	4.64
Mean	0.75	0.93	0.88	1.08	0.92		1.53	1.83	1.90	2.50	1.93		3.73	4.78	5.13	6.08	4.90	
		V	T	V × T				V	T	V × T			V	T	V × T			
C.D		0.07	0.04	0.03				0.15	0.17	0.34			0.30	0.44	0.12			
SE(D)		0.08	0.04	0.03				0.08	0.08	0.17			0.19	0.22	0.43			
SE(M)		0.17	0.08	0.06				0.05	0.06	0.12			0.14	0.15	0.31			

Variety	60 DAS					Mean	75 DAS					Mean	90 DAS					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	8.90	9.00	10.40	12.30	11.00	10.32	13.00	15.70	18.50	16.80	14.70	15.74	19.80	21.40	23.80	28.90	27.60	24.30
JGL 20171	7.60	8.50	11.40	10.50	9.90	9.58	12.70	14.80	15.40	17.80	16.30	15.40	18.70	24.30	25.00	26.70	22.70	23.48
NLR 33671	7.90	9.40	10.30	12.00	11.80	10.28	12.20	14.60	15.90	17.00	16.00	15.14	18.00	21.40	23.70	24.60	22.10	21.96
MTU 1112	7.40	8.20	9.10	10.89	9.00	8.92	12.00	13.80	15.90	16.50	14.20	14.48	18.40	21.00	22.40	25.60	18.90	21.26
Mean	7.95	8.78	10.30	11.42	10.43		12.48	14.73	16.43	17.03	15.30		18.73	22.03	23.73	26.45	22.83	
		V	T	V × T				V	T	V × T			V	T	V × T			
C.D		0.78	0.87	1.30				0.20	0.61	0.43			0.80	0.89	0.63			
SE(D)		0.39	0.43	0.86				1.38	0.68	0.48			2.03	1.00	0.71			
SE(M)		0.27	0.30	0.61				2.10	1.36	0.96			3.20	2.00	1.41			

T₁: Control; T₂: GA₃ @ 1000 ppm; T₃: GA₃ @ 200 ppm + KNO₃ @ 3%; T₄: GA₃ @ 500 ppm + KNO₃ @ 3%; T₅: GA₃ @ 1000 ppm + KNO₃ @ 3%

Table 4: Influence of different seed priming treatments and varieties on days to 50% flowering, productive tillers per plant, grains per panicle (g) and test weight (g) at harvest under pot culture

Variety	Days to 50% flowering					Mean	Productive tiller per plant					Mean	Grains per panicle					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅		T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	76.00	76.00	78.00	74.00	78.00	76.40	5.00	6.00	7.00	10.00	7.00	7.00	113.40	132.50	154.30	231.40	174.80	161.28
JGL 20171	82.00	78.00	76.00	75.00	78.00	77.80	5.00	7.00	8.00	9.00	5.00	6.80	132.50	141.20	138.00	189.70	169.70	154.22
NLR 33671	94.00	90.00	92.00	90.00	102.00	93.60	7.00	8.00	6.00	8.00	6.00	7.00	121.30	134.60	143.60	200.20	124.50	144.84
MTU 1112	101.00	103.00	105.00	100.00	102.00	102.20	6.00	4.00	5.00	8.00	6.00	5.80	100.98	113.40	132.60	198.50	122.50	133.60
Mean	88.25	86.75	87.75	84.75	90.00		5.75	6.25	6.50	8.75	6.00	117.05	130.43	142.13	204.95	147.88		
		V	T	V × T				V	T	V × T			V	T	V × T			
C.D		7.06	NS	NS				0.54	0.60	1.21			5.20	13.54	27.09			
SE(D)		3.48	3.89	7.78				0.27	0.30	0.60			5.97	6.68	13.35			
SE(M)		2.46	2.75	5.50				0.19	0.21	0.42			4.22	4.72	9.44			

Variety	Test weight					Mean
	T ₁	T ₂	T ₃	T ₄	T ₅	
MTU 1010	17.60	18.40	19.70	22.40	21.00	19.82
JGL 20171	16.70	18.30	21.00	21.40	20.80	19.64
NLR 33671	15.80	17.60	19.70	20.90	18.60	18.52
MTU 1112	16.78	18.20	17.90	19.30	19.00	18.24
Mean	16.72	18.13	19.58	21.00	19.85	
		V	T	V × T		
C.D		0.17	1.71	1.20		
SE(D)		0.76	0.85	1.69		
SE(M)		0.53	0.60	1.20		

T₁: Control; T₂: GA₃ @ 1000 ppm; T₃: GA₃ @ 200 ppm + KNO₃ @ 3%; T₄: GA₃ @ 500 ppm + KNO₃ @ 3%; T₅: GA₃ @ 1000 ppm + KNO₃ @ 3%

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