Research on Cultivation Techniques for Salt-Tolerant Rice Variety SHPT15 Growing in the Coastal Regions Affected by Saltwater Intrusion in Thanh Hoa Province, Vietnam

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ABSTRACT
Rice (*Oryza sativa* L.) is a principal food crop in Vietnam. However, rice growing areas and its yield have been significantly reduced due to adverse effects of climate change, especially saltwater intrusion. This study was focused on planting date, density, and fertilizer dosages to determine the appropriate cultivation techniques for the salt-tolerant rice variety SHPT15. This variety was grown in three coastal districts (Nga Son, Hoang Hoa and Quang Xuong, Thanh Hoa province) under the effects of saltwater intrusion in the winter-spring and summer seasons of 2019. The results showed that SHPT15 was a short-growth duration rice variety (118-125 days in the winter-spring season, 100-110 days in the summer season), which is suitable for the cropping season calendar in the coastal districts of Thanh Hoa province. The optimal sowing dates from 27 December to 17 January 17 in the winter-spring season and from 28 May to 18 June ensured the plant growth under favorable conditions, resulting in high yield. There was a significant difference in growth duration between density and fertilization treatments, however, growth duration in the fertilizer treatment P1 tended to be longer than that in the other two treatments P2 and P3. With different fertilizer level applications, at a planting density of 35 plants m^{-2}, the yield of the rice variety SHPT15 was higher than at a planting density of 40-45 plants m^{-2} with statistical significance at 95% of confidence level. The yield of the salt-tolerant rice variety SHPT15 was the highest in the M1P2 treatment, with 61.9 - 68.2 quintals ha^{-1} (in the winter-spring season) and 60.5 - 64.2 quintals ha^{-1} (in the summer season) in the experimental location. Therefore, the rice variety SHPT15 is recommended to be planted at the density of 35 plants m^{-2}, transplanting 02- 03 seedlings per hill with the fertilizer levels for 1 hectare of 450 kg lime + 10 tons of manure or 1 ton of microbial fertilizer + 100 kg N+ 90 kg P_2O_5 + 80 kg K_2O in winter-spring season. In the summer season, the amount of inorganic fertilizer was reduced by 10% compared to the winter-spring season, which is 90 kg N, 80 kg P_2O_5, and 70 kg K_2O.
Keywords: Planting date, density, fertilizer, salt-tolerant rice, coastal region, Thanh Hoa province

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Introduction

Sustainable rice production is considered one of the imperative tasks of Vietnam's agriculture today because rice is a key food crop and provides daily meals for nearly 100 million persons in this country. However, global warming and climate change have led to proliferating severe both abiotic and biotic stresses, which are caused adverse impacts on rice production and rice

cultivating areas (Khanh *et al*., 2021). Salt-affected soils due to seawater rise is considered as an urgent problem in the context that Vietnam is one of the countries most affected by climate change (Linh *et al*., 2012; Bo, 2015). According to the General Statistics Office (2021), the whole year rice growing area in Vietnam reaches 7.24 million ha with the highest average rice yield of 60.6 quintals ha^{-1}. To achieve this success in rice production, apart from prompt responses to complicated weather to properly regulate the cropping calendar, the rice industry has had a strong transformation towards implementing advanced technologies, which have been effectively applied in a range of provinces.

Thanh Hoa province is the fifth largest province in terms of areas in Vietnam and is located in the Northernmost part of the North Central region and the Central Coast of this country. Among the districts, Nga Son, Hoang Hoa and Quang Xuong districts are along coastal areas with over 80% of local people working in agricultural activities. However, recently, rice cultivating areas and production have been detrimentally affected by unpredictable extreme weather as a result of climate change impacts, such as saltwater intrusion, drought, and floods, etc (Anh *et al*., 2016; Nam *et al*., 2022).

A number of studies reported that the application of appropriate seed and fertilizer management along with other improved management and technologies have significantly contributed to increasing rice yield (Uddin *et al*., 2013). Proper application of fertilizers can significantly increase yield and improve rice quality (Awan *et al*., 2003; Ahmed *et al*., 2005; Oikeh *et al*., 2008). Saline soils are characterized by low nutrient ionic activities (macronutrients such as N, P, K, Mg, Ca and micronutrients such as Fe, Mn, Zn, Cu) due to the high ion ratios of Na^+ and Ca^{2+}, Na^+ and K^+, Ca^{2+} and Mg^{2+}, and Cl^- and $NO3^-$ in the soil solution, leading to the limitation of nutrient uptake of plants and their growth (Grattan *et al*., 1992; Bidalia *et al*., 2019). Other studies on macronutrient fertilizers and plant density reported that most farmers tend to apply high doses of nitrogen to a high rice yield (Saleque *et al*., 2004). However, excess application of nitrogen fertilizers can cause damage to crop growth, reduction of crop yield, and increase in production costs. Effective application of nitrogen fertilizers can alleviate the toxicity caused by salinity; thus, nutrient management can contribute to improving the salt tolerance of crops. Application of phosphorus fertilizers is often recommended to improve phosphorus deficiency in saline soils, however, the low efficiency of using phosphorus fertilizer available in the soil due to the influence of salts has limited the ability to supply P from phosphorus fertilizers, so the application of phosphorus fertilizers also causes serious environmental concerns (Dey *et al*., 2021). Potassium application significantly increased photosynthetic potential (Rfd value), effective panicle number, yield and K concentration in straw. Simultaneously, it significantly reduced the concentrations of Na and Mg and thus improved the ratios of K and Na, K and Mg and K and Ca (Bohra and Doerffling, 1993). In addition, plant density is another important factor that plays a critical role in supplying optimal conditions such as solar radiation and nutrient use for rice growth and development (Miah *et al*., 1990). High plant density increases competition among individuals for nutrients, light and water, resulting in maturing at small sizes and declining yield.

The variety SHPT15 is a newly developed salt-tolerant rice variety by Agricultural Genetics Institute, Hano, Vietnam, which can be tolerant to the salinity of approximately 6‰ under an artificial saline experiment. This variety has shown a range of good agronomic characteristics, including small height, and shorter growth duration than the rice variety Bac Thom 7 (BT7) with an average duration of 114-120 days, particularly 115-117 days in the spring season and 102-103 days in the summer season, resistant to major pests and diseases, high potential yield (54.0 to 56.0 quintals ha^{-1}). In order to search for adaptation strategies to

climate change in rice cultivation and develop sustainable rice production in the coastal areas in Thanh Hoa province, apart from selecting salt-tolerant rice varieties with high salinity threshold, it is required to research suitable cultivation techniques for planting these rice varieties to improve production efficiency and reduce the effects of salinization. Therefore, this study aimed to find out the optimal planting date, density and fertilizer dosage for the rice variety SHPT15 to achieve maximum yield in coastal districts of Thanh Hoa province.

Materials and Methods

Plant materials

The rice variety SHPT15 is a promising salt-tolerant variety that was selected from numerous breeding generations between FL478 salt-tolerance variety which was imported from IRRI and the variety BT7 from Vietnam (Linh *et al*., 2020). This variety was developed and provided by Agricultural Genetics Institute (AGI). This variety showed a range of agronomic characteristics with high resistance to major pests and diseases, high potential yield and salinity tolerance of 6 ‰. The experiments including testing planting date, plant density and fertilizer dosages were implemented in three coastal districts of Thanh Hoa province, namely Nga Son, Hoang Hoa, and Quang Xuong in two crop seasons (winter-spring and summer) in 2019.

Field experiments

The experiment to test the effect of planting date on the rice variety SHPT15 was arranged in a randomized completed block design with 3 treatments and 3 replications. Each treatment had 10 days of different sowing and transplanting dates (Table 1). The area of each experimental plot was 30 m^2, in which the plant density was 35 plants m^{-2} with 1-2 seedlings per hill. The fertilizer amount for the winter-spring season was 100 kg N, 90kg P_2O_5, 80 kg K_2O, 10 tons of manure and 450 kg of lime powder; and that for the summer season was 90 kg N, 80 P_2O_5, 70 kg K_2O, 10 tons of manure, and 450 kg lime powder.

Table 1. Planting date experiment in coastal districts in Thanh Hoa in 2019

Winter-spring season		
Treatment	**Sowing date**	**Transplanting date**
CT1	27 December 2019	17 January 2019
CT2	07 January 2019	27 January 2019
CT3	17 January 2019	07 January 2019
Summer season		
Treatment	**Sowing date**	**Transplanting date**
CT1	28 May 2019	13 June 2019
CT2	08 June 2019	23 June 2019
CT3	18 June 2019	03 July 2019

The experiment of the effect of plant density and fertilizer dosages on growth, development, and yield of the rice variety SHPT15 was arranged as a split-plot design in which whole plots were fertilizer factor and split plots were plant density. There were 3

treatments for each factor (Table 2) with 3 replications for each treatment. The area of a split-plot was 10 m^2. The rice seedlings were transplanted at 2-3 seedlings per hill. All treatments were applied with 8 tons of manure, and 450 kg of lime powder.

Table 2. Treatments of fertilizer dosages and plant density

Fertilizer experiment		**Fertilizers in winter-spring season**			**Fertilizers in summer season**			**Density experiment**		**Plant/ m^2**
		N	P_2O_5	K_2O	N	P_2O_5	K_2O			
Fertilizer treatment	P1	120	110	100	110	100	90	Density treatment	M1	35
	P2	100	90	80	90	80	70		M2	40
	P3	80	70	60	70	60	50		M3	45

Data collection and data statistical analysis

The data criteria collected from these experiments included growth duration, plant height, number of panicles per tiller, number of panicles per m^2, number of filled grains, percentage of unfilled grains, yield, and resistance to pests and diseases. The monitoring criteria, methods of assessment and data collection were followed by National Technical Regulation on Testing for Value of Cultivation and Use of Rice varieties (01-55: 2011/BNNPTNT) issued by Ministry of Agriculture and Rural Development of Vietnam. The software Office Excel 2007, IRRISTAT 5.0 and STATISTIX 8.2 for analyzing statistical data collected from the experiments.

Results and Discussion

Effects of planting date on growth and development, and yield components of the rice variety SHPT15

Effects of planting date on growth duration of the rice variety SHPT15

The growth duration is the period from the date that rice seeds germinated to the date that rice plants are harvested. The growth duration depends on geographical conditions, crop varieties, methods of transplanting, and farming management. It is also affected by light, temperature, and fertilizer dosage. Research on growth duration is important for choosing appropriate ecological regions, arranging crop seasons, and determining farming management to reduce the impacts of salinity on plant growth to increase crop yield.

The growth duration of the rice variety SHPT15 in the winter-spring season in the studied location ranged from 119 to 125 days, of which the treatment CT3 had the shortest growth duration (119 – 120 days). In the summer season, the growth duration of this variety was from 100 to 105 days. Thus, there was a significant difference in the growth duration of the rice variety SHPT15 between the winter-spring season and the summer season. The plant height of this variety in both crop seasons ranged from 101.1 to 105.2 cm, in which the treatment CT1 had the highest plant height. The plant height of the rice variety in the treatment CT1 planted in Nga Son, Hoang Hoa, and Quang Xuong in the winter-spring season was 104.1, 102.3, and 105.2, respectively, and in the summer season, it was 103.2, 101.8, and 105. The treatment CT3 had the lowest plant height in both crop seasons (101.3 – 102.8 cm).

Table 3. Agronomic characteristics of the rice variety SHPT15 in the season experiment in Thanh Hoa province in 2019

Location	Treatment	Winter-spring season		Summer season	
		Growth duration (day)	Plant height (cm)	Growth duration (day)	Plant height (cm)
Nga Son	CT1	122	104.1	103	103.2
	CT2	120	103.7	100	102.6
	CT3	119	102.5	100	102.3
Hoang Hoa	CT1	125	102.3	105	101.8
	CT2	123	101.6	103	101.5
	CT3	120	101.3	100	101.1
Quang Xuong	CT1	121	105.2	104	105.0
	CT2	120	104.3	102	103.7
	CT3	119	102.8	100	102.5

Effects of planting date on yield components and yield of the rice variety SHPT15 in Thanh Hoa in 2019

The result showed that the planting date did not affect the number of panicles m^{-2} of the rice variety SHPT15 in both crop seasons. The average number of panicles m^{-2} ranged from 255.7 to 258.9 panicles m^{-2} in the winter-spring season and from 252.9 to 254.2 panicles m^{-2} in the summer season, in which the treatment CT2 had the highest average number of panicles m^{-2}.The average number of filled seeds per panicle of the rice variety SHPT15 ranged from 102.6 to 104.0 in the winter-spring season and from 103.1 to 104.7 in the summer season. There was no significant difference in the number of panicles per tiller among treatments of planting dates, in which the treatment CT2 had the highest number of panicles per tiller. The weight of 100-grain of the rice variety SHPT15 did not significantly affect by planting dates, it ranged from 22.6 to 23.0 g in the winter-spring season, and from 23.1 to 23.2 in the summer season. Planting dates did not significantly affect the yield of the rice variety SHPT15 in both crop seasons. The highest yield was achieved in the treatment of CT2 in both crop seasons. In the winter-spring season, yield in the treatment CT2 ranged from 57.9 to 60.3 quintals ha^{-1}, and in the summer season, it ranged from 57.7 to 60.3 quintals ha^{-1}. In contrast, yield in the treatment CT3 was lowest in both seasons. It was from 57.2 to 59.0 quintals ha^{-1} in the winter-spring season, and from 55.8 to 59.8 quintals ha^{-1}.

In this study, planting dates did not significantly affect yield components and yield of the rice variety SHPT15 in the experiment implemented in three coastal districts of Thanh Hoa. Thus, planting this rice from December 27 to January 17 in the winter-spring season and from May 28 to June 18 can ensure this rice variety grows in favorable conditions, and achieve a high yield.

Table 4. Yield components of the rice variety SHPT15 in the season experiment in Thanh Hoa in 2019

Treatment	Number of panicles per tiller				Number of filled grains per panicle				Unfilled grain percentage (%)				1000-grain weight (g)			
	Quang Xuong	Hoang Hoa	Nga Son	Mean	Quang Xuong	Hoang Hoa	Nga Son	Mean	Quang Xuong	Hoang Hoa	Nga Son	Mean	Quang Xuong	Hoang Hoa	Nga Son	Mean
Winter-spring seasons																
TV1	257.7	255.7	255.7	256.4	103.3	102.3	103.0	102.9	9.3	10	8.7	9.3	23.0	22.8	23.3	23.0
TV2	259.0	256.0	261.7	258.9	103.3	103.3	104.0	103.5	9.2	9.9	8.6	9.2	22.9	22.7	23.2	22.9
TV3	256.7	254.3	256.0	255.7	102.7	102.3	102.7	102.6	10.5	10.2	9.9	10.2	22.9	22.7	23.2	22.6
Summer season																
TV1	253.3	254.0	251.3	252.9	103.7	103.7	103.7	103.7	8.6	8.3	9.0	8.6	23.2	23.0	23.5	23.2
TV2	255.7	255.3	251.7	254.2	104.0	104.7	104.3	104.7	8.4	8.1	8.8	8.5	23.1	22.9	23.4	23.1
TV3	254.0	251.0	254.3	253.1	103.3	102.3	103.7	103.1	10.1	9.8	10.5	10.2	23.1	22..9	23.4	23.1

Table 5. Effects of planting season on yield of SHPT15 in Thanh Hoa Province in 2019

Treatment	Yield in winter-spring season (quintal ha^{-1})				Yield in summer season (quintal ha^{-1})			
	Quang Xuong	Hoang Hoa	Nga Son	Mean	Quang Xuong	Hoang Hoa	Nga Son	Mean
CT1	57.9	57.9	59.7	58.5	57.6	56.1	59.2	57.6
CT2	57.9	60.3	60.3	59.5	59.2	57.7	59.3	58.7
CT3	57.2	59.0	59.0	58.4	57.3	55.8	59.8	57.6
LSD $_{0.05}$		1.26		1.12		1.08		1.20
CV%		7.2				6.7		

Effects of density and fertilizer dosage on the rice variety SHPT15 in growing regions under saltwater intrusion in Thanh Hoa province

Effects of density and fertilizer dosage on growth duration of SHPT15

The growth duration was not significantly different among treatments of planting density and fertilizer dosages. It was from 118 to 125 days in the winter-spring season, and from 103 to 110 days in the summer season. However, the growth duration tended to be longer in the fertilizer dose treatments P2 and P3.

Table 6. Effect of plant density and fertilizer dosages on growth duration of SHPT15 growing in winter-spring and summer seasons 2019 in Thanh Hoa

Treatments	Growth duration (days)					
	Nga Son		Hoang Hoa		Quang Xuong	
	Winter-spring	Summer	Winter-spring	Summer	Winter-spring	Summer
M_1P_1	120	107	125	110	122	105
M_1P_2	120	107	125	110	122	105
M_1P_3	119	105	124	107	121	103
M_2P_1	120	104	125	108	122	105
M_2P_2	119	104	124	108	121	103
M_2P_3	118	103	124	107	121	103
M_3P_1	120	104	125	108	122	104
M_3P_2	118	103	123	107	122	103
M_3P_3	118	103	123	107	121	103

Effects of density and fertilizer dosages on yield components and yield of the rice variety SHPT15

The results of the effects of planting density and fertilizer dosages on yield components of the rice variety SHPT15 planted in coastal districts of Thanh Hoa province were presented in Table 7.

The number of panicles m^{-2} in the winter-spring season ranged from 217.7 to 275.3 in Nga Son, from 210.7 to 268.3 in Hoang Hoa, and from 212.3 to 270 in Quang Xuong. In the summer season, the number of panicles m^{-2} in Nga Son, Hoang Hoa, and Quang Xuong was from 207.7 to 265.3, from 200.7 to 258.3, and from 202.3 to 260.0, respectively. The number of panicles m^{-2} tended to increase with the decrease in planting density, thus, it was highest in

the treatment of 35 plants per hill, and lowest in the treatment of 45 plants per hill. The number of panicles m^{-2} was the lowest in the fertilizer treatment P3 in both crop seasons at all studied sites.

The average number of filled grains per tiller ranged from 113.3 to 131.3 grains in the winter-spring season and from 103.3 to 121.3 grains in the summer season. The number of filled grains was highest at the planting density of 35 plants m^{-2} (P3). At the planting density of 40-45 plants m^{-2}, the fertilizer dosages did not significantly affect the number of filled grains per tiller, ranging from 22.9 to 23.5 g in the winter-spring season, and from 22.0 to 23.1 g in the summer crop. At the density of 35 plants m^{-2}, the number of filled grains per tiller was highest in the fertilizer treatment P2. There was no difference in the percentage of unfilled grains among planting density and fertilizer dosage treatments, it ranged from 9.3 to 13.3% in the winter-spring season, and from 8.3 to 12.3% in the summer season. The percentage of unfilled grains was highest in the density treatment of 45 plants m^{-2} in all treated fertilizer levels.

Planting density and fertilizer dosages had significant effects on the yield of the rice variety SHPT15 in coastal areas of Thanh Hoa province. The yield of this rice variety varied from 51.0 to 68.2 quintals ha^{-1} in the winter-spring season and from 49.9 to 64.2 quintals ha^{-1} in the summer season. At the density treatment of 35 plants m^{-2}, rice yield was highest in all fertilizer treatments. At all density treatment, when fertilizer treatment P2 was applied, the yield was highest in both crop seasons. At all density treatments, there was a significant difference in yield between fertilizer treatments at the 95% confidence level. The treatment of density treatment M1 and fertilizer treatment P2 had the highest yield in all experimental sites in Thanh Hoa province (Table 8).

Our previous studies showed that this variety was grown well in some Northern provinces including Nam Dinh, Bac Giang and Thanh Hoa by application of fertilizer doses 100 kg N +90 Kg P_2O_5+80 kg K20 + 10 tons of cattle manure with a planting density of 50 plants m^2 (Thao *et al* 2021). However, in this study, we focused to evaluate the main agronomic traits of salt-tolerance SHPT15 rice variety in the three coastal districts where are being affected by saltwater intrusion. A planting density of this variety in salt-affected areas should be lower than 35 plants m^{-2} which showed the most suitable for rice growth in this districts.

Table 7. Effect of fertilizer dosages on yield components of the rice variety SHPT15 in Thanh Hoa in 2019

		Nga Son				Hoang Hoa				Quang Xuong			
Density	**Fertilizer**	**Number of panicles per m²**	**Number of filled grains per panicle**	**Unfilled grain percentage (%)**	**1000-grain weight (g)**	**Number of panicles per m²**	**Number of filled grains per panicle**	**Unfilled grain percentage (%)**	**1000-grain weight (g)**	**Number of panicles per m²**	**Number of filled grains per panicle**	**Unfilled grain percentage (%)**	**1000-grain weight (g)**
Winter-spring seasons													
	P_1	270.3	117.3	13.3	23.0	263.3	113.3	12.7	22.8	265.0	115.0	11.4	22.9
M_1	P_2	275.3	123.3	11.7	23.0	268.3	119.3	11.3	22.8	270.0	121.0	10.5	22.9
	P_3	268.3	114.7	12.2	23.1	261.3	110.7	10.3	22.9	263.0	112.3	11.8	23.0
	P_1	259.7	121.3	11.0	23.5	252.7	117.3	10.7	23.3	254.3	119.0	10.1	23.4
M_2	P_2	258.3	125.3	10.1	23.1	251.3	121.3	9.8	22.9	253.0	123.0	9.7	23.0
	P_3	256.7	123.0	9.7	23.2	249.7	119.0	10.0	23.0	251.3	120.7	9.3	23.1
	P_1	220.3	130.3	9.3	23.3	213.3	126.3	9.3	23.1	215.0	128.0	9.5	23.2
M_3	P_2	218.7	131.3	9.0	23.5	211.7	127.3	9.7	23.3	213.3	129.0	9.6	23.4
	P_3	217.7	130.7	8.7	23.3	210.7	126.7	9.6	23.1	212.3	128.4	10.1	23.2
Summer season													
	P_1	250.3	107.3	12.3	22.0	253.3	103.3	11.7	21.8	255.0	105.0	10.4	21.9
M_1	P_2	265.3	113.3	10.7	22.0	258.3	109.3	10.3	21.8	260.0	111.0	9.5	21.9
	P_3	258.3	104.7	11.2	23.1	251.3	100.7	9.3	21.9	253.0	102.3	10.8	22.0
	P_1	249.7	111.3	10.0	22.5	252.7	107.3	9.7	22.3	244.3	109.0	9.1	22.4
M_2	P_2	248.3	115.3	9.1	22.1	241.3	111.3	8.8	21.9	243.0	113.0	8.7	22.0
	P_3	246.7	113.0	8.7	22.2	239.7	109.0	9.0	22.0	241.3	110.7	8.3	22.1
	P_1	210.3	120.3	8.3	22.3	203.3	116.3	8.3	22.1	205.0	118.0	8.5	22.2
M_3	P_2	208.7	121.3	8.0	22.5	201.7	117.3	8.7	22.3	203.3	119.0	8.6	22.4
	P_3	207.7	120.7	7.7	21.3	200.7	116.7	8.6	22.1	202.3	118.4	9.1	22.2

Table 8. Effect of plant density and fertilizer dosages on yield of the rice variety SHPT15 growing in winter-spring and summer 2019 in Thanh Hoa province

	Location											
	Nga Son				**Hoang Hoa**				**Quang Xuong**			
Fertilizer	**P_1**	**P_2**	**P_3**	**Mean**	**P_1**	**P_2**	**P_3**	**Mean**	**P_1**	**P_2**	**P_3**	**Mean**
Density												
						Winter-spring seasons						
M_1	63.1	68.2	61.0	64.1	58.0	63.0	58.0	59.7	59.8	61.9	57.9	59.9
M_2	63.9	64.2	63.2	63.8	58.0	61.0	55.0	58.0	60.7	61.6	60.1	60.8
M_3	56.9	57.4	56.2	56.8	52.0	54.0	51.0	52.3	53.2	54.3	53.8	53.8
Mean	61.3	63.3	60.1	-	56.0	59.3	54.7	-	57.9	59.3	57.3	-
$LSD_{0,05\ (MĐ)}$				2.3				1.5				3.9
$LSD_{0,05\ (PB)}$				4.6				3.9				3.9
$LSD_{0,05(MĐ*PB)}$				6.5				6.8				6.8
$CV_{\%}$				7.7				8.3				6.7
						Summer season						
M_1	61.8	64.2	59.4	61.8	58.1	60.5	55.7	58.1	60.4	62.8	58.0	60.4
M_2	59.3	62.5	56.1	59.3	55.6	58.8	52.4	55.6	57.9	61.1	54.7	57.9
M_3	53.2	55.4	52.6	53.7	50.5	52.7	49.9	51.0	51.8	54.0	51.2	52.3
Mean	58.1	60.7	56.0	-	54.7	57.3	52.7	-	56.7	59.3	54.6	
$LSD_{0.05\ (MĐ)}$				2.8				1.2				2.8
$LSD_{0.05\ (PB)}$				4.6				1.2				2.8
$LSD_{0.05(MĐ*PB)}$				6.6				2.1				4.9
$CV_{\%}$				7.7				8.2				7.9

Conclusions

In conclusion, our findings suggest that the SHPT15 should be grown from December 27 to January 17 in the winter-spring crop and from May 28 to June in the summer-autumn crop in the affected saltwater intrusion in the coastal regions of Thanh Hoa province. The density treatment M1 and fertilizer treatment P2 showed the most effective combination to promote growth and yield enhancement of this variety. For the winter-spring crop, it is advised to transplant the rice variety at a density of 35 plants m^{-2} with 2-3 seedlings per hill, using 450 kg lime, 10 tons of manure or 1 ton of micro-organism fertilizer, 100 kg of N, 90 kg P_2O_5, and 80 kg K_2O per hectare. For the summer-autumn crop, a 10% reduction in inorganic fertilizer is suggested, with 90 kg N, 80 kg P_2O_5, and 70 kg K_2O per hectare. Our attained results have provided an adaptation strategy for the optimal planting date, density and fertilizer dosage for cultivating SHPT15 in the coastal salt-affected areas in Thanh Hoa province.

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