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Tiller Dynamics, Leaf Area and Spad Meter Ofrice Varieties Influenced by Different Spacing Under Semi-Dry Condition

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Abstract

The field experiment was conducted at College of Agriculture, (V. C. Farm), Mandya, University of Agricultural Sciences, Bengaluru, Karnataka, India during *kharif*, 2019 and 2020. Soil from experimental site was under sandy loam in texture with 70.50, 15.80 and 13.70% sand, silt and clay, respectively. Soil was alkaline in reaction with pH of 9.02 and low in electrical conductivity (0.37 dS m^{-1}). The fertility status of the soil at experimental site was low in organic carbon (0.39%), available nitrogen (182.12 kg N ha^{-1}) and available potassium (122.32 kg K_2O ha^{-1}), however it was high in available phosphorus (78.74kg $P_2O_5 ha^{-1}$). Results indicated that maximum leaf area, SPAD meter reading and tiller production at different days observed in narrow spacing (20 cm row spacing) compared to wider row spacing (30 cm row spacing). Among the different varieties tested, significantly higher leaf area, SPAD meter reading and tiller production was recorded in KMP- 175 and Rasi compared to other varieties.

Keywords: Leaf area, rice, SPAD, tiller dynamics

1. Introduction

More than half of the world's population relies on rice as a staple food, making it the most significant crop in the world (Alogaid et al., 2019**)**. Rice serving as the primary food crop for billions of people worldwide, India holds a prominent position among the food crops grown worldwide (Ningaraju et al., 2015, Verma et al., 2019).

More than 90% of the world's rice is grown and consumed in Asia, wherein 60% of the world's population lives (Ajmal et al., 2022, Melie at al., 2021). By 2035, an additional 114 million tonnes of milled rice will need to be produced, or a 26% increase over the current rate, in order to meet the world's demand for rice (Koireng et al., 2019). There aren't many options for expanding the rice-growing area in the near future. Therefore, the required additional rice production must result from an increase in productivity. The main obstacle is achieving this gain while using less water, labour, and chemicals to ensure sustainability over the long term (Siddiq et al., 2011, Aparna et al., 2022) In India, the main method of growing rice is by transplanting seedlings into puddled fields, which is very labour- and energy-intensive and requires 30 man days ha^{-1} (Murthy et al., 2015). Additionally water required for puddling and transplanting are both becoming more expensive and scarce, making rice production less profitable and methane gas emissions from submerged water cultivation contributes towards global warming.

In semi-dry system, seeds are sown in ploughed dry soil with monsoon rains same as aerobic rice and when the monsoon become active the field is impounded in with canal water of a project or bore water and continued as wet land crop (Raj et al., 2014). By practising direct seeding labour and water problem can be controlled to protect soil productivity and the environment while also making rice production more affordable (Lakshmi Bai et al., 2014).

By modern varieties and inexpensive herbicides, dry direct seeding of rice enables early establishment of the following crop and higher profit in locations with reliable water supply (Basavaraja et al., 2010). In order to maximise agricultural energy use and increase rice productivity, it is necessary to look for appropriate crop establishment techniques (Sampath and Srinivas 2017, Rajput et al., 2016). The crucial phenomena on which the yield characteristics and yield potential of a direct-seeded rice crop depend are the cultivar and plant spacing. When compared to broadcasting, sowing with defined row spacing yields a higher yield because natural resources are used more efficiently (Gautam et al., 2018). The right variety choice and better management techniques are the main contributors to yield (Sridhara et al., 2011).

The selection of rice genotypes for higher yields, greater resistance to adverse conditions, and early maturity is another crucial factor (Khalil et al., 2016, Malla reddy et al., 2012). However, the use of suitable and selective location-specific genotypes and varieties with high yield potential, as well as improved cultural practises, are essential components that cannot be ignored if crop production is to be successful. Due to its competitive effects on both vegetative and reproductive development, plant population has a significant impact on the growth and grain yield of rice. As a result, careful manipulation of planting density may increase the economics. Keeping in view such problems an attempt was made with an objective to find tiller dynamics, leaf area and spad meter of rice varieties influenced by different spacing under semi-dry condition

2. Materials and Methods

The field experiment was conducted at College of Agriculture, (V. C. Farm), Mandya, University of Agricultural Sciences, Bengaluru during *kharif* 2019 and 2020, which comes under Southern Dry Zone of Karnataka (Zone-VI). Geographically, place is located at 12° 57’ N Latitude and 76° 82’ E Longitude and at an altitude of 757.10 m above mean sea level the soil from experimental site was under sandy loam in texture with 70.50, 15.80 and 13.70% sand, silt and clay, respectively. Soil was alkaline in reaction with pH of 9.02 and low in electrical conductivity (0.37 dS m^{-1}). The fertility status of the soil at experimental site was low in organic carbon (0.39%), available nitrogen (182.12 kg N ha^{-1}) and available potassium (122.32 kg K_2O ha^{-1}), however it was high in available phosphorus (78.74 kg $P_2O_5 ha^{-1}$). The experiment was replicated trice in split plot design with two row spacing viz., 20 cm and 30 cm row spacing in main plots and eight plant varieties (V_1-KMP-175, V_2- RNR-15048, V_3- RNR-15038, V_4- Rasi, V_5- MTU-1001, V_6-MTU-1010, V_7- IR-64, V_8- Gangavathi sona). Random allocation of treatment was done both in main and sub plots. At the time of sowing phosphorus and potassium were applied @ 50 kg ha^{-1} as per the treatment plan using single super phosphate and muriate of potash as source, respectively. The nitrogenous fertilizer were applied @ 100 kg ha^{-1} given in three splits as (50% as basal at sowing, 25% at maximum tillering and 25% at panicle initiation stage) as urea.

3. Results and Discussion

3.1. Tiller dynamics

The data on tiller dynamics of semi-dry rice as influenced by planting geometry and cultivars recorded at different days intervals are presented in Table 1.

Among the different row spacing, higher tillers m^{-2} was noticed in 20 cm row spacing at different day interval compared to

Table 1: Tiller dynamics of semi:dry rice at different intervals as influenced by planting geometry and varieties

Treatments	34 DAS	38 DAS	42 DAS	46 DAS	Treatments	50 DAS	54 DAS	58 DAS
	Pooled	Pooled	Pooled	Pooled		Pooled	Pooled	Pooled
Spacing (S)					Spacing (M)			
M_1: 20 cm row length	133.8	158.44	193.02	228.96	M_1: 20 cm row length	255.63	291.04	321.77
M_2: 30 cm row length	120.5	137.94	169.38	197.50	M_2: 30 cm row length	215.67	238.88	257.19
SEm±	2.19	2.71	3.45	3.37	SEm±	4.38	4.08	4.05
CD (p=0.05)	NS	16.51	21.00	20.51	CD (p=0.05)	26.65	24.84	24.63
Varieties (T)					Sub plots: Varieties (8)			
T_1: KMP:175	130.08	151.58	184.00	216.58	T_1: KMP:175	245.67	276.92	302.50
T_2: RNR:15048	121.25	140.33	171.50	203.33	T_2: RNR:15048	217.92	235.58	256.50
T_3: RNR:15038	124.92	145.25	176.58	208.08	T_3: RNR:15038	219.58	236.67	248.92
T_4: Rasi	136.83	158.42	191.33	225.83	T_4: Rasi	251.08	291.83	322.17
T_5: MTU:1001	124.33	153.83	193.92	228.08	T_5: MTU:1001	258.25	297.83	329.08
T_6: MTU:1010	142.17	160.00	192.75	224.17	T_6: MTU:1010	246.83	290.00	319.83
T_7: IR:64	121.42	142.33	173.50	203.50	T_7: IR:64	229.67	257.75	279.67
T_8: Gangavathi sona	116.08	133.75	166.00	196.25	T_8: Gangavathi sona	216.17	233.08	257.17
SEm±	3.26	3.54	5.01	4.19	SEm±	5.20	4.43	6.15
CD (p=0.05)	9.45	10.24	14.51	12.14	CD (p=0.05)	15.06	12.84	17.83
Interaction (M×S)					Interaction (M×S)			
SEm±	6.18	7.67	8.86	9.53	SEm±	12.39	11.55	11.45
CD (p=0.05)	NS	NS	NS	NS	CD (p=0.05)	NS	NS	NS

30 cm row spacing. Whereas as in different varieties MTU-1001 produced higher number of tillers m^{-2} at different day's interval compared to other varieties. However, it was on par with Rasi. RNR-15038 recorded lower tillers m^{-2} at different days intervals compared to other varieties. Non-significant interaction was found between planting geometry and varieties.

Among the different spacings, higher tillers m^{-2} was found in 20 cm row spacing. It was mainly due to the increased population and greater nutrient uptake than 30 cm row spacing. The mortality of tiller has been seen due to more below and above the ground competition for space, nutrient, water, air, and light but it is maintained by higher plant population per unit area. Optimum plant population in 20 cm row spacing helped for efficient use of nutrients, moisture, and efficient harvest of solar energy due to lesser weed population might have helped in higher production of tillers m^{-2} compared to wider spacing. The results were in agreement with Joshi et al. (2016) in direct seeded rice; Basha et al. (2017), Gautam et al. (2018) in dry seeded irrigated rice.

3.2. Leaf area (cm^2)

The data on leaf area of semi-dry rice as influenced by planting geometry and cultivars recorded at 30, 60, 90 DAS and at harvest are presented in Table 2.

At 30 DAS leaf area of semi-dry rice significantly influenced by planting geometry and varieties. Among the different spacing significantly higher leaf area (74.5 cm^2) was noticed in 20 cm row spacing compared to (54.3 cm^2) 30 cm row spacing. Among the different varieties KMP- 175 produced significantly higher leaf area (87.92 cm^2) and found on par with MTU-1010 (82.42 cm^2). Gangavathi sona (40.33 cm^2) produced lowest LAI and found on par with RNR-15048 (47.00 cm^2). Interaction between planting geometry and varieties was found non-significant.

At 60 DAS 20 cm row spacing produced significantly higher leaf area (457.38 cm^2) over 30 cm row spacing (361.25 cm^2). Among the different varieties higher leaf area (518.9 cm^2) was noticed in KMP- 175 and it was on par with MTU-1010 (490) and significantly higher superior to other varieties. Lowest leaf area^2 was noticed in Gangavathi sona (294.7 cm^2). Interaction between planting geometry and varieties was found non-significant.

At 90 DAS significantly higher leaf area (1235.81 cm^2) was noticed in 30 cm row spacing compared to (914.46 cm^2) 20 cm row spacing. Among the different varieties KMP- 175 produced significantly higher leaf area (1248.3 cm^2) and found on par with MTU-1010 (1205.9 cm^2). Gangavathi sona (927.1 cm^2) produced lowest leaf area. Interaction between planting geometry and varieties was found non-significant.

At harvest also 20 cm row spacing produced significantly higher leaf area (961.1 cm^2) over 30 cm row spacing (699.8 cm^2). Among the different varieties higher leaf area (997.5 cm^2) was noticed in KMP- 175 and it was on par with MTU-1010 (963.25 cm^2) and significantly higher superior to other varieties. Lowest leaf area was noticed in Gangavathi sona (679.6 cm^2). Interaction between planting geometry and varieties was found non-significant.

Table 2: Leaf area of semi-dry rice at different intervals as influenced by planting geometry and varieties

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
	Pooled	Pooled	Pooled	Pooled
Main plots = Spacing (2)				
M_1: 20 cm row length	54.3	361.3	914.5	699.8
M_2: 30 cm row length	74.5	457.4	1235.8	961.1
SEm±	1.7	9.0	25.3	22.6
CD (p=0.05)	10.1	54.9	154.2	137.3
Sub plots= Varieties (8)				
T_1: KMP:175	87.9	518.9	1248.3	997.5
T_2: RNR:15048	47.0	318.1	953.6	710.3
T_3: RNR:15038	53.4	339.4	983.3	737.2
T_4: Rasi	74.3	448.6	1145.5	905.5
T_5: MTU:1001	61.3	386.9	1055.7	813.8
T_6: MTU:1010	82.4	490.0	1205.9	963.3
T_7: IR:64	68.3	406.7	1081.7	836.8
T_8: Gangavathi sona	40.3	294.7	927.1	679.6
SEm±	2.7	10.4	20.1	20.2
CD (p=0.05)	7.9	30.0	58.3	58.5
Interaction (M×S)				
SEm±	4.70	25.52	71.66	63.82
CD (p=0.05)	NS	NS	NS	NS

Higher leaf area was noticed in 20 cm row spacing compared to 30 cm row spacing. It might be due to effective utilization available resources and production of more number or leaves compared to wider spacing. The more vigorous plants, with particularly higher tillering ability produced more photosynthate than the less vigorous plants at the closer spacing (Murthy et al., 2011, Ashraf et al., 2014). Higher number of tillers per meter square produces more leaves per meter square results in higher leaf area in closer spacing. Light and nutrient availability in wider plant spacing provide a chance to weeds along with the crop to grow easily as compared to narrow plant spacing where chances of weeds to grow were less due to less space availability and high crop-weed competition. More number of leaves per unit results in more LAI hence more Leaf area in same land area consequently traps more light and CO_2 resulting high photosynthesis capacity and produce more dry matter. Similar finding was noticed by Karkee et al., 2020 and Rao et al. (2014).

Among the different cultivar KMP-175 has produced higher leaf area due to taller plant height and production of long and erected leaves compared to other cultivars. These results are in line with Basavaraja et al. (2010), Jadeyegowda (2015).

3.3. SPAD meter reading

The data on SPAD meter reading of semi-dry rice as influenced by planting geometry and cultivars recorded at 30, 60 and 90 DAS are presented in Table 3.

Table 3: SPAD meter reading of semi-dry rice at different intervals as influenced by planting geometry and varieties

Treatments	30 DAS	60 DAS	90 DAS
	Pooled	Pooled	Pooled
Main plots = Spacing (2)			
M_1: 20 cm row length	29.6	37.2	37.1
M_2: 30 cm row length	27.4	33.6	33.7
SEm±	0.37	0.55	0.54
CD (*p*=0.05)	NS	3.35	3.30
Sub plots= Varieties (8)			
T_1: KMP:175	31.4	33.0	32.9
T_2: RNR:15048	26.8	28.7	28.1
T_3: RNR:15038	27.0	28.5	28.4
T_4: Rasi	29.3	30.9	30.8
T_5: MTU:1001	28.1	30.5	30.1
T_6: MTU:1010	31.1	32.9	32.7
T_7: IR:64	28.7	30.6	30.3
T_8: Gangavathi sona	26.1	28.1	28.0
SEm±	0.43	0.62	0.56
CD (*p*=0.05)	1.17	1.85	1.62
Interaction (M×S)			
SEm±	0.56	0.95	1.13
CD (*p*=0.05)	NS	NS	NS

At 30 DAS, SPAD meter reading was found non-significant between different planting geometry. Among the different varieties, significantly higher SPAD meter reading (31.4) was observed in KMP-175 and it was on par with MTU-1010 (31.1) and higher compared to other varieties. The lower dry mater production was observed in Gangavathi sona (26.1). Non-significant interaction was found between planting geometry and varieties.

At 60 DAS and 90 DAS, significantly higher SPAD meter reading was noticed in 20 cm row spacing (37.2 and 37.1) compared to 30 cm row spacing (33.6 and 33.7). Among the different varieties, KMP-175 produced significantly higher dry matter production (33 and 32.9) over other varieties except MTU-1010. Gangavathi sona (28.1 and 28) produced lower higher SPAD meter reading. Interaction between planting geometry and varieties was found non-significant.

20 cm row spacing recorded higher SPAD meter reading. It was mainly due to effective uptakes of applied nitrogen from soil correlated with less competition from the weeds, in case of wider row spacing nutrient losses was more through leaching, volatilization and uptake by weeds. Among the different varieties higher SPAD meter reading was noticed in KMP-175 over other varieties. Higher genetic vigour associated with effective uptake of nutrient increases SPAD meter value compared to other varieties. Similar results were obtained by Malla Reddy et al. (2012) in aerobic rice.

4. Conclusion

Higher tiller dynamics, leaf area and SPAD meter reading was observed in KMP-175 and Rasi varieties in 20 cm row spacing grown in semi-dry condition under Southern Dry Zone of Karnataka

5. References

Ajmal, K.K., Goverdhan, M., Sridevi, S., Suresh, K., 2022. SPAD meter reading, nutrient uptake and nitrogen use efficiency of semi-dry rice under varied doses and time of application. The Pharma Innovation Journal 11(4), 112–117.

Alogaidi, F.F., Shugeairy, Z.A., Hadi, B.H., Hassan, W.A., 2019. Effect of planting distance on yield and yield components of four introduced upland rice varieties under aerobic conditions. Plant Archives 19(1), 699–706.

Aparna, V.B., Mrudhula, A.K., Prasad, P.V.N., Babu, R.M., 2022. Effect of planting geometry and nitrogen levels on growth parameters, yield attributes and yield of black rice. The Pharma Innovation Journal 11(9), 2260–2264.

Ashraf, M.M., 2021, Productivity of paddies as influenced by varied rates of recommended nutrients in conjunction with biofertilizers in local landraces. Agronomy 11(3), 1–19.

Basavaraja, M.K., Murali, K., Siddaram, Ramesha, Y.M., Yogeeshappa, H, Prakash, H., 2010. Effect of spacing and genotypes on growth and yield of aerobic rice. International Journal of Agricultural Science 6(1), 485–487.

Basha, S.J., Basavarajappa, R., Babalad, H.B., 2017. Crop performance and water use efficiency in aerobic rice relative to irrigation schedule, planting geometry and method of planting in northern transition zone of Karnataka, India. Paddy and Water Environment 15(2), 291–298.

Gautam, A., Srivastava, V.K., Verma, V.K., Alok, P., 2018. Effect of varying seed rates and row spacing on growth yield attributes and yields of dry direct seeded rice. International Journal of Agricultural Science 10(7), 5788–5790.

Gautam, A.K., Kumar, D., Shivay, Y.S., Mishra, B.N., 2008.

Influence of nitrogen levels and plant spacing on growth, productivity, and quality of two inbred varieties and a hybrid of aromatic rice. Archives of Agronomy and Soil Science 54(5), 515–532.

Jadeyegowda, M.N., 2015. Studies on varietal performance, planting geometry and intercrops in aerobic rice (*Oryza sativa* L.), Ph.D. Thesis., Univ. Agric. Sci., Bangalore.

Karkee, S.S., Sah, S.K., Marhatta, S., Dhakal, S., Kushwaha., 2019. Assessment of growth and productivity of black rice under different crop geometry and nitrogen management. Agricultural and Forest Meteorology 3(2), 287–300.

Khalil, M.E., Chowdhury, K., Sabag, A.E., Barutculard, C. Islam, M.S., 2016. Effect of planting geometry on yield and yield attributes of aromatic rice genotypes. Agriculture Advances 5(9), 349–357.

Koireng, J., Devi, M., Devi, P., Gogoi, G., Rolling, P.S., 2019. Effect of variety and spacing on the productivity of direct seeded rice (*Oryza sativa* L.) under Manipur condition. Indian Journal of Pure & Applied Biosciences 7(5), 335–341.

Lakshmi Bai, J.K., Murthy, R.K.V., Naidu, V.M., Mahesh, U.V., 2014. Performance of semi-dry rice as affected by graded levels and time of application of nitrogen. The Andhra Agricultural Journal 61(1), 44–48.

Malla Reddy, M., Padmaja, B., Veeranna, G., Reddy, V.V.D., 2012. Evaluation of popular kharif rice (*Oryza sativa* L.) varieties under aerobic condition and their response to nitrogen dose. The Journal of Research ANGRAU 40(4), 14–19.

Melie, F.M., Joseph, B.M Liliane, T., Felix, F., Dorothy, M., 2021. Effect of plant spacing on the growth and yield of rainfed rice (*Oryza sativa*) in the bimodal rain forest zone of Cameroon. Journal of Agriculture and Crops 7(2), 49–58.

Murthy, K.M.D., Rao, A., Vijay, D., Sridhar, T.V., 2015. Effect of levels of nitrogen, phosphorus and potassium on performance of rice. Indian Journal of Agricultural Research 49(1), 83−87.

Murthy, P., Prasad, R.S., Siddaraju, R., Lakshmi, J., 2011. Influence of varieties and spacing on growth, seed yield and quality of rice under aerobic condition. The Mysore Journal of Agricultural Sciences 45(3), 521–527.

Ningaraju, G.K., Ramachandra, N., Shivakumar, M., Rajanna, P., Krishnamurthy, R., 2015. Studies on response of varieties and different dates of sowing on productivity of aerobic rice. Journal of Rice Research 3(2), 1–3.

Raj, S.K., Bindhu, J.S., Girijadevi, L., 2014. Nitrogen availability and uptake as influenced by time of application and N sources in semi-dry rice. Journal of Crop and Weed 10(2), 295−302.

Rajput, A., Rajput, S.S., Jha, G., 2016. Performance of rice varieties grown under different spacings with planting depths in system of rice intensification. International Journal of Agriculture, Environment and Biotechnology 9(5), 833–838.

Sampath, O., Srinivas, A., 2017. Evaluation of fertilizer use efficiency in rice varieties as influenced by combination of plant density and fertilizer levels. International Journal of Agricultural Science Research 7(2), 217–222.

Siddiq, S., Anayat, A., Sattar, A., Ali, M.A., Yaseen, M., 2011. Response of different rice (*Oryza sativa* L.) cultivars to different NPK levels different NPK levels in the central cropping zone of Punjab. Agricultural Science Digest 31(3), 155–160.

Verma, B., Ramteke, L.K.M., Shahid, 2019. Effect of plant spacing on growth and yield of rice (*Oryza sativa* L.) under submerged condition. Journal of Experimental Agriculture International 33(3), 1–6.