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Evaluating the Performance of Rice in Different Intercropping Systems under Aerobic Rice Cultivation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The investigation entitled Evaluating the performance of rice in different intercropping systems under aerobic rice cultivation was conducted during *kharif* seasons of 2021-22 and 2022-23 at MRRC, NAU, Navsari. The experiment was carried out in Randomized Block Design with four replication. Results revealed that growth parameters of different intercrops were slightly affected by different intercropping system as compared to sole crop. Yield attributes like panicle length, panicle weight and 1000 grain weight of sole rice crop were significantly higher as compared to other intercropping system but which was at par with treatment Rice + Sorghum (6:2) and Rice +

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Soybean (6: 2) for panicle length. Grain and straw yield of sole rice were recorded significantly higher as compared other intercropping system during individual year as well as pooled analysis. Significantly higher rice equivalent yield was recorded under treatment T_1: Rice + Sorghum (6:2) over rest of the treatments.

Keywords: Intercropping; rice; aerobic cultivation; growth; yield parameters.

1. INTRODUCTION

Rice is the one of the predominant cereal crop of India and the world. It is expected that by the year 2025, some of irrigated dry and wet-season rice will experience physical water scarcity [1,2]. The water scarcity due to these shifts in use and the need to reduce water inputs will affect many aspects of crop management, variety choice, soil quality, organic matter, pest population, productivity and the environmental impact of these intensive rice based systems. Rice crop consumes about 90 per cent of the fresh water resources. Traditional rice production system not only leads to wastage of water but also causes other problems [3,4]. Hence, aerobic rice is one of the option to minimize irrigation requirement of rice crop. Higher productivity in any crop can be achieved through ideal varieties with suitable agronomic practices. Information on the intercropping on the yield of the cultivars of rice under aerobic method is less. Intercropping of rice with vegetable and pulse crops is an emerging concept [5,6]. The main objective is to achieve a substantial increase in rice yield along with yield of intercrop for building soil fertility. With this background, efforts were made to investigate suitable intercropping under aerobic method of rice cultivation with its leading varieties [7].

2. MATERIALS AND METHODS

A field experiment entitled Evaluating the performance of rice in different intercropping systems under aerobic rice cultivation was conducted during *kharif* seasons of 2021-22 and 2022-23 at MRRC, NAU, Navsari.The experimental site was clay in texture, low in organic carbon (0.55, 0.51 and 0.55%) and available nitrogen (227, 251 and 279 kg/ha), high in available phosphorus (140.5, 141.2 and 143.2 kg/ha) and available potassium (737.9, 857 and 860.2 kg/ha). The soil was found slightly alkaline (pH 7.90, 7.93 and 7.78) with electrical conductivity (0.61, 0.56 and 0.53 dS/m).The experiment was laid out in Randomized Block Design with four replication. Seven treatments namely,T_1: Rice + Sorghum (6:2), T_2: Rice + Soybean (6:2), T_3: Rice + Sorghum (4:2), T_4:Rice + Soybean (4 :2), T_5:Rice, T_6:Sorghum, T_7: Soybean. Rice cultivar GNR-8, Sorghum GNJ-1, Soybean Phule agrani were sown with a seed rate using 50, 12-15 and 60-70 kg/ha respectively with 30 cm line sowing. The crops were fertilized with as their recommended dose. Irrigation application as per requirement of crops [8].

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

Three year pooled data of growth and growth attributes of rice and intercrops are presented in Table 1. The result revealed that the different intercropping system significantly influenced the growth and growth attributes of rice crop. Among the different treatments, plant height, dry matter/plant at 60 and 90 DAS, total tillers/m^2 and days to 50 % flowering of rice crop were recorded significantly higher under treatment T_5: Rice as compared to different intercropping system [9].

3.2 Yield Attributes

The pooled data presented in Table 2 showed that the yield attributes *viz.*, panicle length, panicle weight and 1000 grain weight of rice crop significantly affected by different intercropping system. The data revealed that the panicle length, panicle weight and 1000 grain weight of sole rice (T_5) crop were significantly higher as compared to other intercropping system but which was at par with treatment T_1: Rice + Sorghum (6:2) and T_2: Rice + Soybean (6: 2) for panicle length [10].

3.3 Grain and Straw Yield

The data pertaining to grain and straw yield of rice crop during individual year as well as pooled analysis were presented in Table 3. The results revealed that the grain and straw yield of sole rice (T_5) were recorded significantly higher as compared other intercropping system during individual year as well as pooled analysis which was significantly on par with T_2: Rice + Soybean (6: 2).

Table 1. Effect of different intercropping system on growth and growth attributes of rice (pooled)

Treatments	Plant height at harvest (cm)	Dry matter/plant (g)		Total tillers/m^2 at harvest	Days to 50 % flowering
		At 60 DAS	At 90 DAS		
T_1: Rice + Sorghum (6 : 2)	117.82	11.91	16.73	288.92	85.63
T_2 :Rice + Soybean (6 : 2)	117.94	12.07	16.69	285.25	83.89
T_3: Rice + Sorghum (4 : 2)	109.00	11.19	13.92	265.67	85.76
T_4: Rice + Soybean (4 : 2)	117.14	11.30	15.71	282.33	83.94
T_5 : Rice	125.10	13.58	17.74	294.67	89.30
SEm±	1.53	0.08	0.11	0.96	0.88
CD (p=0.05)	5.00	0.25	0.36	3.14	2.87
CV%	5.11	8.29	9.59	3.99	3.13
Y					
SEm±	1.34	0.22	0.35	2.53	0.60
CD (p=0.05)	NS	NS	NS	NS	NS
Y X T					
SEm±	3.00	0.50	0.78	5.65	1.34
CD (p=0.05)	NS	NS	NS	NS	NS

Note: This table included rice intercropping system analysis

Table 2. Effect of different intercropping system on yield attributes of rice (pooled of three years)

Treatments	Panicle length (cm)	Panicle weight (g)	1000 grain weight (g)
T_1: Rice + Sorghum (6 : 2)	25.76	3.23	28.12
T_2 :Rice + Soybean (6 : 2)	25.46	3.21	27.74
T_3: Rice + Sorghum (4 : 2)	23.12	2.89	26.78
T_4: Rice + Soybean (4 : 2)	24.43	3.28	27.51
T_5 : Rice	26.51	3.56	30.99
SEm±	0.43	0.06	0.21
CD (p=0.05)	1.40	0.20	0.69
CV%	5.13	8.49	6.20
Y			
SEm±	0.29	0.06	0.39
CD (p=0.05)	NS	NS	NS
Y X T			
SEm±	0.64	0.14	0.87
CD (p=0.05)	NS	NS	NS

Table 3. Effect of different intercropping system on grain and straw yield of rice

Treatments	Grain yield (kg/ha)				Straw yield (kg/ha)			
	2021	2022	2023	Pooled	2021	2022	2023	Pooled
T_1: Rice + Sorghum (6 : 2)	3862	4102	4082	4015	5131	5187	5203	5174
T_2 :Rice + Soybean (6 : 2)	3908	4145	4111	4055	4995	5306	5273	5191
T_3: Rice + Sorghum (4 : 2)	3404	3613	3590	3536	4804	4966	4928	4900
T_4: Rice + Soybean (4 : 2)	3551	3901	3890	3780	4568	4738	4694	4667
T_5 : Rice	5123	5210	5102	5145	6523	6650	6619	6598
SEm±	162.4	153.9	151.4	39.01	198.6	203.9	205.1	29.42
CD (p=0.05)	500	474	467	127	612	628	632	95.93
CV%	8.2	7.3	7.3	7.6	7.6	7.6	7.7	7.64
Y								
SEm±				69.75				90.59
CD (p=0.05)				NS				NS
Y X T								
SEm±				155.96				202.57
CD (p=0.05)				NS				NS

Table 4. Effect of different intercropping system on rice equivalent yield

Treatments	Rice equivalent yield (t/ha)			
	2021	2022	2023	Pooled
T_1: Rice + Sorghum (6 : 2)	9.16	9.49	9.41	9.35
T_2 :Rice + Soybean (6 : 2)	8.00	8.39	8.29	8.22
T_3: Rice + Sorghum (4 : 2)	8.69	8.98	8.92	8.86
T_4: Rice + Soybean (4 : 2)	7.30	7.79	7.67	7.59
T_5 : Rice	6.55	6.66	6.55	6.59
T_6 : Sorghum	8.67	8.74	8.72	8.72
T_7 : Soybean	4.11	3.92	3.82	3.95
SEm±	0.31	0.19	0.21	0.08
CD (p=0.05)	0.92	0.60	0.65	0.24
CV%	8.3	4.9	5.7	6.47
Y				
S.Em.±	-	-	-	0.09
C.D. at 5%	-	-	-	NS
Y X T				
SEm±	-	-	-	0.25
CD (p=0.05)	-	-	-	NS

3.4 Rice Equivalent Yield

The individual year as well as pooled data presented in Table 4 showed that the rice equivalent yield was significantly affected by different intercropping system. Significantly higher rice equivalent yield was recorded under treatment T_1: Rice + Sorghum (6:2) over rest of the treatments during individual year as well as pooled analysis but which was at par with treatment T_3 : Rice + Sorghum (4 : 2) and T_6 : Sorghum during first and treatment T_3: Rice + Sorghum (4 : 2) during second and third year. The treatment T_1: Rice + Sorghum (6:2) recorded higher significant rice equivalent yield in pooled analysis.

4. CONCLUSION

Based on the rice equivalent yield, it can be concluded that for achieving higher yield from aerobic rice intercropping system under south Gujarat, sowing six lines of aerobic rice and two lines of sorghum as intercrop with 30 cm line spacing which resulted higher rice equivalent yield.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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