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Full Length Research Paper

Matrix of correlation between paddy yield, weeds, growth and yield components of lowland rice at Talata Mafara, Sudan Savanna ecological zone

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ABSTRACT: In order to investigate the interrelationship between paddy yield, weeds, growth and yield components of rice, a field experiment was conducted in each of the wet seasons of 2012 and 2013 at Irrigation Research Stations of the Institute for Agricultural Research located at Bakolori Irrigation Scheme Talata Mafara, Zamfara State in the Sudan Savanna ecological zone of Nigeria(12° 34' N; 06° 04'E). The treatment consisted of four (4) weed management practice (Oxadiazon at 1.0 kg a.i ha^{-1} [pre-emergence], Orizo-plus [proponil 360 g/l + 2,4-D 200 g/l] at 2.8 kg a.i ha^{-1}[post emergence at 3 WAS], manual weeding [at 3 and 6 WAS] and weedy check [control]); three (3) each of seeding method (Drilling, Dibbling and Broadcast) and seed rate (40 kg ha^{-1}; 70 kg ha^{-1}; 100 kg ha^{-1}). The experiment was laid in a split plot design replicated three times. Weed management practice was assigned to the main plots while the combination of seeding method and seed rate to the subplots. Data were collected on plant height, leaf area, crop dry matter, tillering ability, crop growth rate, Harvest index (HI), Panicle length, number of grains per panicle, 1000-grain weight and paddy yield. Crop dry matter exhibited maximum positive direct effect on paddy yield followed by 1000-grain weight, panicle length and number of tillers per square meter. There was positive and significant association between paddy yield and growth and yield attributes suggests that, priority be given to these traits when making selection for improvement.

Keywords: Paddy yield, weeds, growth and yield components of lowland, Sudan savanna ecological zone

INTRODUCTION

Rice (*Oryza sativa* L.) is monocot, annual, semi aquatic cereal crop and belongs to the family Poaceae. The genus, to which it belongs, *Oryza*, contains 25 species, only two of which are referred to as cultivated rice: *Oryza sativa* sown in South-East Asian, and *Oryza glaberrima* in West Africa (Singh *et al*., 2015). The world's total rice, paddy production was estimated at 757 million tonnes in 2019. China is the top country by rice, paddy production in the world. As of 2019, rice, paddy production in China was 211 million tonnes that accounts for 27.92% of the world's rice, paddy production. The top 5 countries (others are India, Indonesia, Bangladesh, and Viet Nam) account for 71.53% of it. In 2019, rice, paddy production for Nigeria was 8.44 million tonnes (FAOSTAT, 2020). Correlation analysis is generally performed to understand the association of the yield with the agronomic characters of a crop variety. Some morphological traits associated with plant growth attributes of rice have been found to have close relationship with yielding ability of rice variety (Yang *et al*., 2007). Selection of traits contributing simultaneously to a character will improve it in subsequent development of crop (Nor *et al*., 2013). The correlation analysis is therefore necessary to determine the direction of selection and the numbers of characteristics need to be considered in improving any character such as grain yield. Investigation of the interrelationship between yield and its components will improve the efficiency of breeding program with appropriate selection criteria. A correlation coefficient tells whether there is relationship between two variables and whether the relationship is positive or negative and how strong or weak the relationship (Bello et al., 2010). Positive correlation between yield and yield components is required for effective yield component breeding tailored towards increasing grain yield in rice (Ogunbayo *et al*., 2014). So, it is important for plant breeders to understand the degree of correlation between yield and its components.

Agahi *et al*. (2007) observed that grain yield was positively significantly correlated with number of productive tillers , days to maturity, flag leaf length , flag leaf width and plant height. Zahid *et al*. (2006) reported that paddy yield had significant positive correlation with the, days to maturity and 1000-grain weight. Kole *et al*.

(2008) reported positive and significant correlation of grain yield with plant height, but negative and significant correlation with days to 50% flowering at both genotypic and phenotypic levels. Plant height was significantly and positively correlated with panicle length. Akhtar *et al*. (2011) reported negative non-significant association of plant height and positive significant correlation of 1000-grain weight with paddy yield at phenotypic level. Fiyaz *et al*. (2011) reported number of productive tillers, days to 50 percent flowering and plant height had significant positive association with grain yield. Yadav *et al*. (2011) studied the extent of genetic association between yield and its components. Grain yield was significantly and positive correlation with number of effective tiller per hill, panicle length and 1000 grain weight at phenotypic levels and negative correlation with days of 50% flowering and plant height .In their study, (Sawant *et al*., 1995; Debchoudhary and Das, 1998) reported that, days to 50 per cent flowering exhibited a positive and significant association with days to maturity, number of effective tillers per plant, plant height and panicle length. Similar results were reported by Deepa Sankar *et al*. (2006) and Singh *et al*. (2006). However, negative and significant association was noticed with number of grains per panicle and kernel breadth. Ravindra Babu *et al*. (2012), reported negative and significant associations for number of effective tillers per plant with panicle length, number of grains per panicle and 1000-grain weight. For the improvement of grain yield, the knowledge on the association between grain yield and its component characters will be helpful. The present study was, therefore, undertaken to understand the association among rice grain yield and its components and growth characters.

MATERIALS AND METHODS

A field experiment was concurrently conducted in each of the wet seasons of 2012 and 2013 at Irrigation Research Stations of the Institute for Agricultural Research located at Bakolori Irrigation Scheme Talata Mafara, Zamfara State in the Sudan Savanna ecological zone of Nigeria. The treatment consisted of four (4) weed management practice (Oxadiazon at 1.0 kg a.i ha^{-1} [pre-emergence], Orizo-plus [proponil 360 g/l + 2,4-D 200 g/l] at 2.8 kg a.i ha^{-1}[post emergence at 3 WAS], manual weeding [at 3 and 6 WAS] and weedy check [control]); three (3) each of seeding method (Drilling, Dibbling and Broadcast) and seed rate (40 kg ha^{-1}; 70 kg ha^{-1}; 100 kg ha^{-1}). The experiment was laid in a split plot design replicated three times. Weed management practice was assigned to the main plots while the combination of seeding method and seed rate to the subplots.SIPI-602033 (FARO 44) was used for the experiment. The experimental field in each season and site was double harrowed to obtain a fine tilth. The land was thereafter manually prepared into check basins. Gross plot size was 3.0 m by 2.0 m (6.0 m^2) and the net plot size was 2.0 m by 1.6 m (3.2 m ^{2}).The seed was sown as per seeding method and seeding rate treatments. The seed was sown on rows, 20 cm apart in both drilled and dibbled plots 10 rows per plot, each 3 m long and at 20 cm between stands in dibbled plots, giving 15 stands per row. Inorganic fertilizer was applied by broadcast at the rate of 60 kg ha^{-1} N; 60 kg ha^{-1} P_2O_5; 60 kg ha^{-1} K_2O at planting using a compound fertilizer NPK 15:15:15. The second application of 60 kg ha^{-1} N was done at 6 WAS using Urea (46%) as a source of N.

Data were collected on plant height, leaf area, crop dry matter, tillering ability, crop growth rate, Harvest index (HI), Panicle length, number of grains per panicle, 1000-grain weight and paddy yield. Data collected from the observations were subjected to analysis of variance. The magnitude of relationship between characters was determined through simple correlation analysis as described by Little and Hills (1978).

RESULTS

The result of correlation analysis between paddy yield, weed parameters, growth and yield components of rice in 2012 and 2013 and the mean of the years at Talata Mafara are shown in (Tables 1-3). In 2012, paddy yield was found to be significantly and positively correlated with crop dry matter (r = 0.86**), leaf area (r = 0.77**), crop growth rate (r = 0.81**), tillering ability (r = 0.59**), harvest index (r = 0.26*), panicle length (r = 0.51**), number of grains per panicle (r = 0.49**) and 1000-grain weight (r = 0.653**) while the paddy yield was significantly and negatively correlated with weed dry weight (r = -0.66**). Generally weed dry matter negatively and significantly correlated with all the parameters sampled except harvest index where the relationship was not significant. However, crop dry matter was positively and significantly correlated with leaf area (r = 0.871**), crop growth rate (r = 0.97**), tillering ability (r = 0.45**), panicle length (r = 0.52*), number of grains per panicle (r = 0.32**) and 1000-grain weight (r = 0.38**). No correlation was observed between harvest index with panicle length, number of grains per panicle and 1000 grain weight respectively. In 2013, paddy yield significantly and positively related to crop dry matter (r=0.73**), leaf area (r=0.61**), tillering ability (r=0.52**) harvest index (r=0.99**), panicle length (r=0.48**), number of grains per panicle (r = 0.44**) and 1000-grain weight (r=0.59**). Paddy yield relationship with crop growth rate (r=0.20) though positive but was not significant. The relationship between paddy yield and weed dry weight though significant (r =-0.48**) but was negative. Tillering ability was highly significant with harvest index but positively and significantly correlated with panicle length (r = 0.52**), number of grain per

Table 1: Matrix of correlation between paddy yield, weeds, growth and yield components of rice at Talata Mafara in 2012 wet season.

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	-0.657**	1.000								
3	0.864**	-0.667**	1.000							
4	0.771**	-0.630**	0.871**	1.000						
5	0.814**	-0.600**	0.966**	0.786**	1.000					
6	0.594**	-0.360**	0.448**	0.448**	0.433**	1.000				
7	0.259*	-0.185	0.205	0.205	0.360**	0.038	1.000			
8	0.506**	-0.613**	0.518**	0.511**	0.441**	0.342*	0.176	1.000		
9	0.493**	-0.420**	0.433**	0.485**	0.380**	0.253*	0.083	0.322*	1.000	
10	0.653**	-0.361**	0.327*	0.291*	0.268*	0.174	0.129	0.383**	0.192	1.000

Df = n-2 (106) ** significant at 1% * significant at 5% of probability

1. Paddy yield
2. Weed dry weight kg ha^{-1}
3. Crop dry matter $plant^{-1}$
4. Leaf area
5. Crop growth rate
6. Tillering ability
7. Harvest index
8. Panicle length
9. Number of grains $panicle^{-1}$
10. 1000 grain weight

Table 2: Matrix of correlation between paddy yield, weeds, growth and yield components of rice at Talata Mafara in 2013 wet season

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	-0.480**	1.000								
3	0.727**	-0.519**	1.000							
4	0.614**	-0.516**	0.787**	1.000						
5	0.202	0.270*	0.106	-0.254*	1.000					
6	0.524**	-0.365**	0.108	0.072	-0.022	1.000				
7	0.993**	-0.517**	0.628**	0.629**	-0.231	0.242	1.000			
8	0.481**	-0.761**	0.415**	0.522**	-0.373**	0.384**	0.520**	1.000		
9	0.439**	-0.575**	0.429**	0.461**	-0.305*	0.294*	0.464**	0.728**	1.000	
10	0.587**	-0.501**	0.483**	0.445**	-0.134	0.308*	0.592**	0.558**	0.405**	1.000

Df = n-2 (106) ** significant at 1% * significant at 5% of probability

1. Paddy yield, 2 Weed dry weight kg ha^{-1}, 3 Crop dry matter $plant^{-1}$, 4 Leaf area, 5 Crop growth rate, 6 Tillering ability, 7 Harvest index, 8 Panicle length, 9 Number of grains $panicle^{-1}$, 10 1000 grain weight

Table 3: Matrix of correlation between paddy yield, weeds, growth and yield components of rice at Talata Mafara in Mean data

	1	2	3	4	5	6	7	8	9	10
1	1.000									
2	-0.506**	1.000								
3	0.852**	-0.547**	1.000							
4	0.158	-0.151	0.104	1.000						
5	0.576**	-0.222*	0.641**	-0.624**	1.000					
6	0.393**	-0.364**	0.338**	0.060	0.194*	1.000				
7	-0.085	-0.004	-0.046	0.767**	-0.598**	-0.012	1.000			
8	0.489**	-0.459**	0.115	0.722**	-0.494**	0.241*	0.594**	1.000		
9	0.462**	-0.239*	-0.018	0.763**	-0.608**	0.126	0.643**	0.775**	1.000	
10	0.467**	-0.410**	0.449**	-0.531**	0.680**	0.209*	0.605**	-0.226*	-0.413**	1.000

Df = n-2 (214) ** significant at 1% * significant at 5% of probability . 1.Paddy yield, 2. Weed dry weight kg ha^{-1}, 3. Crop dry matter plant^{-1} ,4. Leaf area, 5.Crop growth rate, 6. Tillering ability , 7. Harvest index , 8. Panicle length 9.Number of grains panicle^{-1},10. 1000 grain weight

panicle (r = 0.46**) and 1000-grain weight (r = 0.59**). Also crop dry matter had positive and significant relation with all the yield attributes such as panicle length, number of grain per panicle and 1000-grain weight. Crop growth rate was negatively and significantly correlated with panicle length (r = 0.37**) and number of grains per panicle (r = -0.30*). In the mean at Talata Mafara, it showed that paddy yield significantly and positively related to crop dry matter (r=0.85**), crop growth rate (r=0.58**), tillering ability (r=0.393**), panicle length (r=0.49**),number of grains per panicle (r = 0.46**) and 1000-grain weight (r=0.47**). The weed parameter was negatively and significantly correlated with paddy yield as indicated in weed dry matter (r = -0.51**).

DISCUSSION

Complete knowledge on interrelationship of plant character like paddy yield with other characters is of paramount importance to breeders in making decisions for improvement in complex quantitative character like paddy yield for which direct selection is not much effective. The positive and significant association between paddy yield and growth and yield attributes suggests that, priority be given to these traits when making selection for improvement. Crop dry matter exhibited maximum positive direct effect on paddy yield followed by 1000-grain weight, panicle length and number of tillers per square meter. Positive direct effects of these traits on paddy yield indicated their importance in determining this complex character and therefore, should be kept in mind while practicing selection aimed at improving paddy yield. Similar results were also reported by Jayasudha and Sharma (2010) and Zulqarnain *et al*. (2012) on number of tillers per plant and filled grains per panicle. Leaf area expressed negative direct effect on paddy yield. This is because the attribute which is in association do not exist by themselves, but are linked to other components.

Conclusion

Grain yield per plant was observed to be positively and significantly associated with crop dry matter plant^{-1} , Leaf area, Crop growth rate, Tillering ability, Harvest index, Panicle length, Number of grains panicle^{-1} and 1000 grain weight, indicating the importance of these traits as selection criterion in yield enhancement programmes.

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