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Research article

CORRELATION STUDIES BETWEEN PHYSICO-CHEMICAL, CHEMICAL AND NUTRIENT UPTAKES OF PADDY IN PHOSPHORUS RICH VERTISOLS

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ABSTRACT: A field experiment was conducted in paddy having high soil available P vertisols under K.C. Canal ayacut at Regional Agricultural Research Station, Nandyal, Andhra Pradesh. The correlation studies revealed that there exist a positive strong correlation between agronomic characters at different stages with the yield. pH and EC was positively correlate with yield except pH at panicle initiation stage is non significantly correlate with yield. The available nitrogen at tillering (r= 0.446), panicle initiation (r= 0.299) and harvest stages (r= 0.502) showed non-significant results with yield. The soil available phosphorus at tillering (r=0.782) and panicle initiation stages (r= 0.743) showed positive and significant correlation at 1 per cent level of significance, but available phosphorus at harvest stage (r= 0.683) showed positive and significant correlation at 5 per cent level of significance. The yield of paddy is positively and significantly correlated with nitrogen uptake in straw (r= 0.812), phosphorus uptake in grain (r= 0.946), straw (r= 0.860) and potassium uptake in straw (r= 0.725) showed positive and significant correlation with yield at 1 per cent level of significance.

Key words: Correlations, pH, EC, Available N P K, rice yield, N P K uptake

INTRODUCTION

Phosphorus is one of the major nutrients required for production of rice. The use efficiency of phosphorus is very low due to fixation in soil in addition to poor solubility of native soil phosphorus. Plants utilize few amounts of phosphatic fertilizers that are applied and the remaining portion is rapidly converted into insoluble complexes in the soil. In soil more than 80% of P becomes immobile and unavailable for plant uptake because of adsorption, precipitation, or conversion to organic form. In recent years, use of excess and/or indiscriminate amounts of fertilizers has created problem of multiple nutrient deficiencies, diminishing soil fertility and unsustainable crop yields. A field experiment conducted in high soil available P Vertisols under K.C. Canal ayacut. Of late it was observed that the soils under irrigated canal commands especially under paddy crop are showing high soil available P status (Annual Progress Reports of AICRP, 1984). This is resulted due to excess addition of P containing complex fertilizers over years, like DAP (18:46:0), 28:28:0, etc., which were applied as basal dose and top dressing. It was found to occur mainly in places where intensive cultivation is being followed under irrigation commands with indiscriminate use of not only this nutrient but also fertilizers containing other nutrients. Keeping in mind the significance of organic manures in maintaining soil health and improvement in productivity of crops.

MATERIAL AND METHODS

A field experiment was conducted during *kharif* 2011 at Regional Agricultural Research Station, Nandyal, Kurnool district of Andhra Pradesh. The soil of the experimental site was clay loam in texture, medium in OC (0.43%), low in available N (227 kg ha^{-1}) but high in available P (153 kg ha^{-1}) and K (596 kg ha^{-1}). The experiment was laid out in a randomized block design and each treatment replicated thrice.

The soil samples were taken at tillering, panicle initiation and at harvest stages and analyzed for pH, EC, N, P and K content. The sample plots were collected plot wise at different stages of crop growth stages were dried at 60 ^{0}C and ground in a Wiley Mill and sieved through 20 mesh screen. These powdered plant samples were analyzed for N, P_2O_5 and K_2O contents at different stages by adopting standard procedures. The phosphorus was determined by colorimetric method (Olsen *et al*., 1954), nitrogen by alkaline potassium permanganate method (Subbiah and Asija, 1956) and potassium by flame photometric method (Jackson, 1973). The nutrient uptake was computed by multiplying the crop biomass with the nutrient content and recorded in kg ha^{-1}. Rice was the test crop with RDF applied as N: P2O5:K2O @ 200:80:80 Kg ha^{-1}. All the manures and fertilizers are applied as per the treatments. The mean maximum and minimum temperatures during crop growth period ranged from 32.2°C and 19.8°C respectively. The treatments were laid out in a randomized block design and each treatment replicated thrice. The experiment comprised of twelve treatments. T_1: Absolute control (no manure and fertilizers), T_2: Farm yard manure (FYM) @ 5 t ha^{-1} only, T_3: Green manure (GM) ploughed *insitu* only, T_4: 100% Recommended Dose of P for paddy (80 Kg P_2O_5 ha^{-1}), T_5 : 50% Recommended Dose of P for paddy (40 Kg P_2O_5 ha^{-1}), T_6 : 25% Recommended Dose of P for paddy (20 Kg P_2O_5 ha^{-1}), T_7 : Recommended Dose of N and K only (No P_2O_5), T_8:T_5 + FYM@5t/ha only (T_2), T_9 :T_5 + Green manure only (T_3), T_{10}:T_6 + FYM@5t/ha only (T_2), T_{11}:T_6 + Green manure only (T_3), T_{12}:Soil Test Based Fertilizer (STBF) application.

RESULTS AND DISCUSSION

Correlation coefficients (r) between agronomic characters and yield of paddy

The present study indicated that, agronomic characters (plant height, dry matter production and number of tillers/ m^2) at different stages of paddy influenced the yield of paddy. The yield was positively correlate with agronomic characters at different stages of crop. Correlation matrix (Table 1) shows that, yield was positively and significant correlation with plant height at tillering (r=0.760), panicle initiation stage (r=0.753), harvest stage (r=0.650). The yield is positively and significantly correlated with the dry matter production at tillering stage (r= 0.660) and panicle initiation stage (r= 0.607) at 5 % level of significance. The yield is also positively and significantly correlated with the dry matter production at harvest stage(r= 0.879) at 1 and 5 % level of significance.

Number of tillers at tillering stage (r=0.725), PI stage (r = 0.691), harvesting stage (r = 0.676) are positively and significantly correlated with yield at 1 and 5 % level of significance.

The results indicate that agronomic characters at different stages shows positively correlate with the yield.

Interaction between soil physico-chemical characters with yield

The relationship between soil physico-chemical characteristics at different stages of paddy were worked out at 1 per cent and 5 per cent level of significance (r= 0.708) and (r= 0.536), respectively, through correlation analysis of the data. The correlations between physico-chemical characters at different stages of paddy with yield were presented in table Table 2. The pH of the soil at is positively and non-significantly correlated with the yield at tillering (r = 0.176) and harvesting stage (r =0.006) at level of significance and negatively non-significantly at panicle initiation stage (r = -0.247). The EC of the soil at is positively and non-significantly correlated with the yield at tillering (r = 0.328), Panicle initiation stage (r = 0.275) and harvesting stage (r =0.172) at level of significance

Correlation coefficients (r) between available nitrogen, phosphorus and potassium at different stages of paddy in soil with yield

The correlations between chemical characters at different stages of paddy with yield were presented in table Table 3. The results showed that available nitrogen, phosphorus and potassium at different stages showed positive correlation with yield. The available nitrogen at tillering (r= 0.446), panicle initiation (r= 0.299) and harvest stages (r= 0.502) showed non-significant results with yield at 1 per cent and 5 per cent level of significance. The soil available phosphorus at tillering (r=0.782) and panicle initiation stages (r= 0.743) showed positive and significant correlation at 1 per cent level of significance, but available phosphorus at harvest stage (r= 0.683) showed positive and significant correlation at 5 per cent level of significance. It reveals that the yield increases with increase in available nutrient status. Increase in yield is due to the availability of major nutrients to plants for efficient growth. The available potassium at tillering (r= 0.305) and panicle initiation (r= 0.068) showed non-significant results with yield 1 per cent and 5 per cent level of significance.

Table 1. Correlation coefficients (r) between agronomic characters at different stages of paddy with yield

	Plant height at TS	Plant height at PIS	Plant height at HS	Dry matter production at TS	Dry matter production at PIS	Dry matter production at HS	Number of tillers/m^2 at TS	Number of tillers/m^2 at PIS	Number of tillers/m^2 at HS	Yield
Plant height at TS	1									
Plant height at PIS	0.932	1								
Plant height at HS	0.868	0.939	1							
Dry matter production at TS	0.954	0.892	0.825	1						
Dry matter production at PIS	0.928	0.875	0.823	0.952	1					
Dry matter production at HS	0.917	0.886	0.813	0.847	0.834	1				
Number of tillers/m^2 at TS	0.889	0.862	0.737	0.861	0.790	0.854	1			
Number of tillers/m^2 at PIS	0.917	0.857	0.753	0.870	0.795	0.852	0.975	1		
Number of tillers/m^2 at HS	0.899	0.808	0.765	0.867	0.789	0.887	0.910	0.945	1	
Yield	0.760	0.753	0.650	0.660	0.607	0.879	0.725	0.691	0.676	1

TS= Tillering stage, PIS= Panicle initiation stage, HS= Harvest stage

Table 2. Correlation coefficients (r) between physico-chemical characters at different stages of paddy with yield

	pH at TS	pH at PIS	pH at HS	EC at TS	EC at PIS	EC at HS	Yield
pH at TS	1.000						
pH at PIS	0.536	1.000					
pH at HS	0.382	0.512	1.000				
EC at TS	0.188	0.114	-0.161	1.000			
EC at PIS	-0.023	-0.357	-0.353	0.789	1.000		
EC at HS	0.232	-0.204	-0.332	0.516	0.715	1.000	
Yield	0.176	-0.247	0.006	0.328	0.275	0.172	1.000

Table 5. Correlation coefficients (r) between yields attributes of paddy with yield

Variable	**Correlation coefficient (r)**
Test weight	0.879
Panicle length	0.755
No of grains/panicle	0.709
filled grains/panicle	0.728
yield	1.000

Correlation coefficients (r) between nitrogen, phosphorus and potassium uptakes at different stages of paddy with yield

Correlation matrix (Table 4) shows that, the interaction between major nutrients uptake at different stages of paddy with yield revealed that there is a positive and significant correlation between the major nutrients uptake with yield. The yield of paddy is positively and significantly correlated with nitrogen uptake at tillering (r= 0.705), panicle initiation (r= 0.788), phosphorus uptake at tillering stage (r= 0.939), panicle initiation stage (r= 0.854) at 1 and 5 % level of significance and potassium uptake at tillering stage (r= 0.674), panicle initiation stage (r= 0.613) showed positive and significant correlation with yield at 5 per cent level of significance. The yield of paddy is positively and significantly correlated with nitrogen uptake in straw (r= 0.812), phosphorus uptake in grain (r= 0.946), straw (r= 0.860) and potassium uptake in straw (r= 0.725) showed positive and significant correlation with yield at 1 per cent level of significance. The results revealed that nutrient uptake at different stages showed positive correlation with yield. Increase in nutrient uptake leads to increase in yield of crop. The similar results were reported by Reddy and Uma Devi (2013).

Table 3. Correlation coefficients (r) between available nitrogen, phosphorus and potassium at different stages of paddy in soil with yield

	Available N at TS	Available N at PIS	Available N at HS	Available P TS	Available P PIS	Available P at HS	Available K at TS	Available K at PIS	Available K at HS	Yield
Available N at TS	1.000									
Available N at PIS	0.382	1.000								
Available N at HS	0.545	0.415	1.000							
Available P at TS	0.456	0.553	0.542	1.000						
Available P at PIS	0.259	0.534	0.367	0.848	1.000					
Available P at HS	0.160	0.470	0.665	0.808	0.708	1.000				
Available K at TS	0.546	0.539	0.644	0.617	0.423	0.644	1.000			
Available K at PIS	0.339	0.714	0.393	0.493	0.353	0.525	0.791	1.000		
Available K at HS	0.491	0.564	0.702	0.614	0.602	0.682	0.632	0.676	1.000	
Yield	0.446	0.299	0.502	0.782	0.743	0.683	0.305	0.068	0.545	1.000

TS= Tillering stage, PIS= Panicle initiation stage, HS= Harvest stage

Table 4. Correlation coefficients (r) between nitrogen, phosphorus and potassium uptakes at different stages of paddy with yield

	N at TS	N at PIS	N in grain	N in straw	P at TS	P at PIS	P in grain	P in straw	K at TS	K at PIS	K in grain	K in straw	Yield
N uptake at TS	1.000												
N uptake at PIS	0.864	1.000											
N uptake in grain	0.715	0.786	1.000										
N uptake in straw	0.747	0.912	0.640	1.000									
P uptake at TS	0.787	0.889	0.688	0.856	1.000								
P uptake at PIS	0.845	0.913	0.757	0.852	0.916	1.000							
P uptake in grain	0.591	0.758	0.707	0.769	0.873	0.867	1.000						
P uptake in straw	0.788	0.860	0.732	0.781	0.858	0.879	0.859	1.000					
K uptake at TS	0.858	0.794	0.531	0.718	0.769	0.803	0.614	0.779	1.000				
K uptake at PIS	0.948	0.877	0.775	0.737	0.741	0.860	0.557	0.769	0.802	1.000			
K uptake in grain	0.238	0.438	0.391	0.545	0.243	0.275	0.411	0.264	0.267	0.172	1.000		
K uptake in straw	0.871	0.877	0.769	0.723	0.788	0.808	0.670	0.870	0.903	0.838	0.344	1.000	
Yield	0.705	0.788	0.697	0.812	0.939	0.854	0.946	0.860	0.674	0.613	0.365	0.725	1.000

Correlation coefficients (r) between yields attributes of paddy with yield

The relationship between yield attributes (test weight, panicle length, number of filled grains per panicle and number of filled grains per panicle) with yield were reported in Table 5. The results revealed that yield attributing characters showed positive and significant correlation with yield at 1 per cent level of significance.

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