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Effect of Vigore and Tabsil on growth, yield and economics of transplanted rice in lowlands

R. A. SINGH, G. SINGH, T. KUMAR, V. KUMAR AND A. L. UPADHYAY
Narendra Dev University of Agriculture and Technology,
Crop Research Station, Ghaghraghat, P.O. Jarwal Road,
Bahraich, Uttar Pradesh - 271901

ABSTRACT

A field experiment was conducted during Kharif 2015 and 2016 at the Crop Research Station, Ghaghraghat, Bahraich, U.P. to study the effect of nutrient management on yield, and economics of transplanted rice in low lands. Results revealed that, growth and yield attributes were improved significantly with 100% RDF + Vigore @ 625gha^{-1} as basal + Vigore sprayed @ 125g L^{-1} of water at 25 days after transplanting (T_3) over rest of the treatment except 100% RDF + Vigore @625g ha^{-1} as basal (T_2). The percent increase in grain yield due to 100% RDF + Vigore @ 625g ha^{-1} + spray @1.25g L^{-1} of water at 25 DAT (T_3) was recorded to the tune of 5.3, 9.4, 20.4, 27.3, 29.5, 58.9 and 55.5 over 100% RDF + Vigore @ 625g ha^{-1} as basal (T_2), 100% RDF + Silica tablet @ 2.5Kg ha^{-1} at 25 days after transplanting (T_4), 100% RDF + Silica tablet @ 2.5Kg ha^{-1} each at 25 and 50 days after transplanting (T_6), 100% RDF + Silica tablet @ 5.0 Kg ha^{-1} sprayed at 50 DAT (T_5), 100% RDF (T_1), Farmers practice (T_7) and control (T_8), respectively. The uptake of nitrogen, phosphorus and potash was also followed the same trend as in case of grain and straw yield and being highest 115.5 N + 22.30 P_2O_5 + 129.5 K_2O Kg ha^{-1} with 100%, RDF + Vigore @ 625 gha^{-1} as basal + 1 spray @ 1.25g L^{-1} of water at 25 DAT (T_3). This treatment (T_3) also gave the highest net income (Rs. 35807 ha^{-1}) however, benefit: cost ratio was recorded highest with 100% RDF + Vigore @ 625 gha^{-1} as basal (T_2).

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INTRODUCTION

Rice is one of the oldest and widest grown food crops of the world. It is also the major source of nutrition for more than half of the rice eating population. In India, it is cultivated in about 44 million hectare land with the production of 104 million tones. At current rate of population growth of 1.8% per annum, the rice requirement of the country is estimated to be around 140-160 million tones by 2020. Uttar Pradesh, the 2nd largest rice producing state of the country with an area of 5.9 million hectare. Average rice productivity of the state is about 2.8 t ha^{-1} which is much below the national average. Among the various factors for low productivity of rice, deficiency of micro and secondary nutrient and imbalance use of fertilizer resulted decreasing organic carbon contents of soil are utmost important.

Vigore is a nanotechnology product which includes all the nutrients required for complete and healthy development of the plant. It is an eco-friendly product and nontoxic for human, animals and plants as it has been prepared from substances found in nature by using infinite decimal doses and with the process of denomination and potentiality which increase effectiveness and remove toxicity. Vigore was applied 5-10 days after transplanting of rice @ 625g ha^{-1} as broadcast method.

Tabsil or Silica tablets a Geolife Bombay product. In recent year, the application of nanotechnology has led to the production of granulated and liquid silicon fertilizers with high bio availability. The new silicon fertilizers can easily penetrate the leaves and form a thick silicate layer on leaf surface. The product is 100% soluble silicate acid and very efficient in preventing lodging, pest diseases infestation and enhances the growth and grain yield. Adequate supply of silica is essential for rice plant through the entire growth period particularly in and after the stage of panicle primordia formation. Silicon promotes photosynthesis keeping the leaf erect and prevents fungal and insect injury and also alleviates lodging. It also increases the supply of oxygen to the rice plant roots. This alleviates the toxicity of H_2S and the harm the any excessive amount of ferrous iron.

There is therefore urgent need to test the effectiveness of these two products (Vigore and Tabsil) alongwith recommended dose of fertilizer in rice plant. Hence, an attempt was made to study the effectiveness of Tabsil and Vigore alogwith recommended dose of fertilizer on productivity and economic feasibility of rice under lowland conditions.

MATERIALS AND METHODS

A field experiment was conducted during Kharif 2015 and 2016 at the Crop Research Station, Ghaghraghat, Bahraich, U.P. to study the effect of vigore and tabsil on yield and economics of rice in rainfed lowlands. The soil of the experimental site was sandy loam in texture with pH 8.1, organic carbon 0.43%, available nitrogen 210 Kg ha^{-1}, phosphorus 15.6 Kg ha^{-1} and potash 189 Kg ha^{-1}, Bulk density 1.40 Mg m^{-3}. The eight treatments comprised of 100% recommended dose of fertilizer (RDF) i.e. 120N + 60 P_20_5 + 40 K_2O Kg ha^{-1}. (T_1), 100% RDF + Vigor @ 625g ha^{-1} as basal (T_2), 100% RDF + Vigore @ 625g ha^{-1} as basal + spray of Vigore @ 1.25 g L^{-1} of water at 25 days after transplanting (T_3), 100% RDF + spray of Silicon Tablet @ 2.5 kg ha^{-1} at 25 days after transplanting (T_4), 100% RDF + spray of Silicon tablet @ 5.0Kg ha^{-1} at 50 days after transplanting (T_5), 100% RDF + spray of Silica tablet @ 2.5 Kg ha^{-1} each at 25 and 50 days after transplanting (T_6), Farmers practices (80 Kg N + 40 Kg P_20_5 ha^{-1} (T_7) and control (T_8) were tested in randomized block design with four replications. The recommended dose of fertilizer i.e. 120 N + 60 P_20_5 + 40 K_2O Kg ha^{-1} was applied as 1/2 N + full P_20_5 + full K_2O at sowing as basal, and rest amount of nitrogen applied in two splits i.e. at maximum tillering and panicle initiation stage. Vigore was applied 5-10 days after transplanting rice @ 625g ha^{-1} as broadcast method.

The vigore and tabsil were applied as per treatment. The data on growth like plant height and leaf area was recorded at 90 days stage. Leaf area index (LAI) was calculated as leaf area per plant divided by ground area covered by plant. The data on yield attributes were collected from 10 panicles selected randomly from each plot just before harvest of rice. The data on 1000-grain weight was recorded from the grain samples drawn from each plot at threshing of rice crop. The content of N, P and K in grain and straw was determine from the grain and straw sample drawn plot wise at harvest by adopting standard laboratory method. The uptake of nitrogen, phosphorous and potassium was calculated by multiplying the content of N, P and K into grain and straw yield and divided by 100. The data collected on growth, yield, yield attributes and nutrient uptake were subjected to statistical analysis as per statistical procedure given in Chandel (1978).

RESULTS AND DISCUSSION

Application of 100% recommended dose of fertilizer (RDF) produced significantly higher grain (38.35qha^{-1}) and straw yield (51.77qha^{-1}) over farmer's practice and control treatment. This treatment increased the grain yield to the tune of 23.1% and 55.5% over farmer's practices and control, respectively.

Rice fertilized with 100% RDF + Vigore @ 2.5 Kg ha^{-1} as basal + 1.25g L^{-1} of water as foliar spray at 25 days after transplanting (T_3) recorded significantly highest grain (49.53 q ha^{-1}) and straw (67.24 q ha^{-1}) yield over rest of the treatments except 100% RDF + Vigore @ 625 gha^{-1} as basal (T_2).

Application of 100% RDF + Vigore @ 625 g ha^{-1} basal (T_2) and 100% RDF + Silica @ 2.5 Kg ha^{-1}sprayed at 25 days after transplanting (T_4) being on par but produced significantly higher grain and straw yield over rest of the treatment except 100% RDF + Vigore @ 625 q ha^{-1} as basal + spray @ 1.25g L^{-1} at 25 days after transplanting (T_3).

Among the silica and tabsil treatments, rice fertilized with 100% RDF + Silica tablet @ 2.5 Kg ha^{-1} at 25 DAT (T_4), produced significantly higher grain yield (45.27 q ha^{-1}) as compared to rest of the silica tablet treatments (Table 1).

The percent increase in grain yield due to 100% RDF + Vigore @ 625gha^{-1} basal + vigore sprayed @ 1.25 g L^{-1} at 25 days after transplanting (T_3) was recorded to the tune of 5.3, 9.4, 20.4, 27.3, 29.5, 58.9 and 55.5 over 100% RDF + vigore @ 625 g ha^{-1} basal (T_2), 100% RDF + spray of silica tablet @ 2.5 Kg ha^{-1} at 25 days after transplanting (T_4), 100 % RDF + spray of silica tablet @ 2.5 Kg ha^{-1} each at 25 and 50 DAT (T_6), 100 % RDF + spray of silica tablet @ 5.0 Kg ha^{-1} at 50 DAT (T_5), 100 % RDF (T_1), Farmers practice (T_7) and control (T_8), respectively.

The higher yield with 100 % RDF + vigore @ 625 g ha^{-1} as basal + spray @ 1.25 g L^{-1} of water at 25 DAT (T_3) was mainly due to higher growth in term of leaf area index, and yield attributes like panicles m^{-2}, panicle length, panicle weight, grain panicle^{-1}, grain weight panicle^{-1} and 1000-grain weight owing to improvement in availability of plant nutrients through improved root system and higher uptake of nutrients from soil by improving photosynthesis efficiency of plant. However, increase in rice yield with silicon tablet application alongwith 100% RDF over 100% RDF (T_1), Farmer practice (T_7) might be due to increased availability of silicon in soil solution. The lower yield of 100% RDF (T_1) without silicon might be

due to leading to fixation loss of native silicon in submerged conditions which is unavoidable to meet out the Silicon requirement by the crop.

The increase in yield with silicon application could be due to beneficial effect Viz; decreasing mutual shading by improving leaf erectness, decreasing susceptibility to lodging, decreasing the incidence of infections with root parasites and pathogens, leaf pathogens and preventing manganese and iron toxicity or both. Increase water use efficiency observed with the application of Si, probably might be due to prevention of excessive transpiration. During reproductive stage, silicon is preferentially transported into the flag leaves and interruption of silicon supply at this stage is determinated for spikelet fertility (Ma *et al*., 2006), Chen *et at*., (2011) stated that silicon application increased grain yield by increase of spikelet number, filled spikelet percentage and 1000-seed weight.

NUTRIENT UPTAKE

The uptake of N, P and K by rice (Grain + Straw) was ranged i.e. 52.21 to 115.2 Kg ha^{-1}, 11.50 to 22.3 Kg P_2O_5 ha^1 and 63.9 to 129.2 Kg K_2O ha^{-1} The higher uptake i.e. 115.2 N, 22.30 P_2O_5 and 129.2 K_2O Kg ha^{-1} was recorded with 100% RDF + Vigore @ 625 g ha^{-1} as basal and spray @1.25 g L^{-1} of water at 25 days after transplanting (T_3). However, the minimum uptake of N, P and K was recorded with control (T_8). Among the silica tablet treatments, the significantly highest uptake i.e. 105.4 N, 20.0 P_2O_5 and 118.4 K_2O kg ha^{-1} was recorded with 100% RDF + silica tablet @ 2.5 kg ha^{-1} at 25 DAT (T_4) followed by 100% RDF + silica tablet @ 2.5 kg ha^{-1} each at 25 and 50 DAT (T_6). The higher uptake of N, P and K with silica tablet treatments was mainly due to improvement in yield owing to the fact that integration of nitrogen with silica could regulate the absorption and mobility of nitrogen, translocation phosphorous and potassium in plant and maintained optimum level of these nutrients, hence improved the use efficiency of above nutrient, resulted in higher uptake. Similar results were obtained by Ghanbari (2011) and Gerami *et al*., (2012). Increased P contents in grain and straw can be attributed to enhanced translocation of P from root to shoot due to silica application. Increased in silica level ultimately increased the absorption of K and CO_2 contents thus it block the hatches and improve the photosynthesis (Gerami *et al*., 2012) .

Table 1: Grain and straw yield as affected by various integrated nutrient management practices.

Treatment	Yield (q ha^{-1})					
	Grain			Straw		
	2015	2016	Mean	2015	2016	Mean
RDF (120N + 60P_2O_5 + 40 K_2O Kg ha^{-1}) I F	38.80	37.90	38.35	52.38	51.16	51.77
RDF + Vigore @ 625 g ha^{-1} Basal	47.69	46.40	47.05	64.38	63.10	63.74
RDF + Vigore @ 625 g ha^{-1} Basal + spray @ 1.25 g L^{-1} of water at 25 DAT	50.26	48.80	49.53	68.10	66.37	67.24
RDF + Silica Tablets @ 2.5 Kg ha^{-1} 25 DAT	45.83	44.70	45.27	62.05	60.34	61.20
RDF + Silica Tablets @ 5.0 Kg ha^{-1} at 50 DAT	39.42	38.40	38.91	53.41	52.07	52.74
RDF + Silica Tablets @ 2.5 Kg ha^{-1} each at 25 & 50 DAT	41.90	40.40	41.15	56.73	54.94	55.83
Farmers Practice (80 N + 40 P_2O_5 Kg ha^{-1})	31.72	30.60	31.16	42.88	41.61	42.25
Absolute Control (No fertilizer)	24.22	25.10	24.66	32.94	34.14	33.54
S : Em ±	1.21	1.08	1.12	1.64	1.41	1.56
CD (P = 0.05)	2.69	2.50	2.60	4.10	3.39	3.79

Table 2: Growth and yield attributes of rice as affected by various integrated nutrient management practices.

Treatment	Leaf area index (LAI) (90DAT)	Panicles m^{-2}	Panicle length (cm)	Panicle weight (g)	Grains $panicle^{-1}$	Grain weight $Panicle^{-1}$ (g)	1000 - grain weight (g)
RDF (120N + 60P_2O_5 + 40 K_2O Kg ha^{-1}) I F	4.81	298	25.87	2.29	92	1.42	24.40
RDF + Vigore @ 625 g ha^{-1} Basal (B)	5.60	344	26.35	2.67	115	1.62	24.95
RDF + Vigore @ 625 g ha^{-1} B + spray of Vigore @ 1.25 g L^{-1} of water at 25 DAT	5.73	356	26.50	2.75	120	1.70	25.10
RDF + Silica Tablets @ 2.5 Kg ha^{-1} 25 DAT	5.49	338	26.21	2.58	110	1.60	24.80
RDF + Silica Tablets @ 5.0 Kg ha^{-1} at 50 DAT	5.10	310	25.97	2.31	96	1.46	24.30
RDF + Silica Tablets @ 2.5 Kg ha^{-1} each at 25 & 50 DAT	5.25	325	26.10	2.47	102	1.52	24.64
Farmers Practice (80kg N + 40 P_2O_5 kg ha^{-1})	3.11	270	25.73	2.10	85	1.35	22.10

Absolute Control	2.97	215	23.70	1.90	72	1.22	19.50
S : Em ±	0.38	0.35	0.22	0.14	05	0.08	0.09
CD (P = 0.05)	0.95	0.75	0.55	0.25	10	0.17	0.25

Table 3: Nutrients uptake and economics as affected by various integrated nutrient management practices.

Treatment	Nutrients uptake (Kg ha^{-1})				Economics			
	N	P	K	Total	Cost of Cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	Benefit : Cost ratio
100% RDF + (120N + 60P_2O_5 + 40 K_2O Kg ha^{-1}) I F	84.23	17.68	102.13	204.04	30847	56278	25431	0.82
100% RDF + Vigore @ 625 g ha^{-1} Basal	109.46	20.23	123.59	253.28	33872	69057	35185	1.03
100% RDF + Vigore @ 625 g ha^{-1} Basal + spray @ 1.25 g L^{-1} of water at 25 DAT	115.15	22.30	129.15	266.60	36897	72704	35807	0.97
100% RDF + Silica Tablets @ 2.5 Kg ha^{-1} at 25 DAT	105.42	20.04	118.41	243.87	37497	66438	28941	0.77
100% RDF + Silica Tablets @ 5.0 Kg ha^{-1} at 50 DAT	90.53	18.29	103.44	212.26	43997	57411	13414	0.30
100% RDF + Silica Tablets @ 2.5 Kg ha^{-1} each at 25 & 50 DAT	94.67	18.99	109.89	223.55	44147	60402	16255	0.37
Farmers Practice (80kg N + 40 kg P_2O_5 ha^{-1})	72.73	14.68	82.33	169.74	28956	45737	16781	0.58
Control	52.23	11.45	63.99	127.67	25000	36201	11201	0.45
S : Em ±	2.47	0.88	2.42	2.33	-	-	-	-
CD (P = 0.05)	5.84	2.10	5.70	5.69	-	-	-	-

ECONOMICS

Rice Crop fertilized with 100% RDF + Vigore @ 625g ha^{-1} as basal and spray @1.25 g L^{-1} of water at 25 days after transplanting (T_3) gave the highest gross income (Rs.72704 ha^{-1}) and net income (Rs. 35807 ha^{-1}) followed by 100% RDF + Vigore @ 625 gha^{-1} as basal (T_2) with gross income of Rs.69057 ha^{-1} and net income (Rs. 35185 ha^{-1}). However, benefit: cost ratio was highest (2.03) with later treatment (T_2) as compared to former treatment (T_3) which is mainly due to marginal increase in yield as compared to cost incurred in treatment (T_3).

Among the silica tablet treatment (T_4, T_5 and T_6), application of 100% RDF + Silica tablet @ 2.5 Kg ha^{-1} at 25 DAT (T_4) recorded the higher gross income (Rs.66438 ha^{-1}), net income (Rs.28941 ha^{-1} and benefit : cost ratio (1.77) followed by 100% RDF + 2 spray of Silica tablet @ 2.5 Kg ha^{-1} each at 25 and 50 DAT (T_6) due to higher cost and lower yield with (T_6). Application of heavy dose of silica tablet @ 5.0 Kg ha^{-1} at 50 DAT (T_5) was not found economical due to lower yield.

It is concluded from the above results that rice crop should be fertilized either with 100% RDF + Vigore @ 625 g ha^{-1} as basal or 100% RDF + Vigore @ 625 g ha^{-1} as basal + spray of Vigore @ 1.25 g L^{-1} of water at 25 days after transplanting to obtain the higher yield and benefit: cost ratio.

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