International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 1062-1064

Received: 21-03-2019
Accepted: 25-04-2019

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Effect of fertilizer levels on yields and nutrients uptake by wheat (*Triticum aestivum* L.) under partially reclaimed coastal salt affected soil of South Gujarat

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Abstract
The field experiment was carried out at Coastal soil salinity research station, Navsari Agricultural University, Danti during *rabi* seasons of 2016-17 and 2017-18 to study the effect of different levels of fertilizer on yield and nutrient uptake of wheat under partially reclaimed coastal salt affected soil of South Gujarat. The result revealed that higher level of fertilizer *i.e.* 120% RDF treatment (F_3) significantly influenced the yield attributes like effective tillers, spike length, spikelets spike^{-1} grains spike^{-1} *etc.*, and yield of wheat, also significantly influenced the nutrients uptake *i.e.* nitrogen, phosphorus and potassium after harvest of crop. The 120% RDF (216-108-00 kg NPK ha^{-1}) treatment registered significantly the highest grain yield were 4292 and 3499 kg ha^{-1} and straw yield were 5803 and 4843 kg ha^{-1} during 2016-17 and 2017-18 respectively. The lowest grain (4292 and 3499 kg ha^{-1}), straw yield (5803 and 4843 kg ha^{-1}) and nutrient uptake were observed under lower dose of fertilizer *i.e.* 80% RDF treatment (F_1).Significantly the highest uptake of nitrogen, phosphorus and higher uptake of potassium were observed in 120% RDF treatment (F_3) during both the years of experimentation.

Keywords: wheat, fertilizer levels, yield and nutrient uptake etc.

Introduction
Wheat (*Triticum aestivum* L.) is the most widely grown and consumed food crop and it is staple food for 35% of the world population. Wheat is very important cereal crop after rice grown under diverse agro-climatic conditions. Globally, wheat is grown on 290.10 million hectares area with production of 730 million tonnes and average productivity is 2717 kg ha^{-1} (Anon., 2016a) [1]. Wheat is grown in an area of 30.17 million hectares and producing 91.53 million tonnes with an average productivity of 3033 kg ha^{-1} (Anon., 2016b) [2]. Among the different states, Punjab, Haryana, Rajasthan, Madhya Pradesh and Uttar Pradesh are the major states cultivate the wheat crop. Coastal area salinity is due to marine influence, periodical inundation with tidal water, proximity to sea, high water tables with high concentration of salts in it. Saline soils in coastal area having predominance of sodium chloride and sodium sulphate salts with abundance of soluble cations with dominance of Na followed by Mg, Ca and K and chloride as the predominant anion followed by sulphate. Out of 6.74 M ha of total salt affected soils in India, about 2.22 M ha of land in Gujarat state alone has already out of cultivation due to salinity and sodicity problems. It is hypothesized that increasing fertilization rate of N and P may significantly improve plant response to salinity. Fertilizers constitute an integral part of improved crop-production technology. Proper amount of fertilizer application is considered a key to the bumper crop production (Tariq *et al.*, 2007) [12]. Inorganic fertilizers hold the key to desired increase in yield of food-grain. Many research findings showed that there is a direct relationship between increased balanced fertilizer uses for higher crop yields. Salt affected soils alters the uptake of nutrients by plants but the use of fertilizers alleviates to some extent the detrimental effects of moderate salinity and help to improve the economic yield of crops. Therefore, in addition to other agronomic practices, successful crop production in salt affected soils demands of judicious use of plant nutrients was required. Soil salinity and sodicity inhibit plant growth through inducing water stress, specific ion effect and nutrient imbalance resulting deficiency of some nutrients while toxicity of others which might cause reduction in growth and yield. Yaduvanshi and Dey (2009) [14] reviewed a series of experiments and recommended should receive 25% N over and above the recommended rates for non-saline/sodic soils.

that rice and wheat crops grown in salt affected soils However, very less information reported on the fertilizer management in wheat crop under salt affected area in South Gujarat. Keeping with these points, the study be carried out on land configuration with integrated nutrient management in wheat (*Triticum aestivum* L.) under partially reclaimed coastal salt affected soil

Materials and Methods

The experiment were carried out at Coastal soil salinity research station, Navsari Agricultural University, Danti which is located about one km away from the Arabian Sea towards East and geographically at 20º 83‟N latitude and 72º52‟E longitude with altitude of 2.5 m above mean sea level. The soil is classified as "Calcareous soil" characterized by very high clay content, with good moisture holding capacity and low to very low permeability. The soils develop deep cracks and become extremely hard when dry, while plastic and sticky when wet. The average thickness of solum ranged from 2.5 to 3.0 m. The rooting depth is extended up to 1.0 m. The soil of the experimental field was clayey in texture, bulk density (1.65 gcc^{-1}) slightly alkaline in pH (8.38 to 8.35), medium in salinity $EC_{2.5}$ (2.01 to 2.04 dS m^{-1}), low in OC (0.42 to 0.43 6%) CEC (40.70 to 44.05 [cmol(p^+) kg^{-1}] and ESP (12.25 to 12.77 [cmol(p^+) kg^{-1}] partially saline-sodic and showed medium, medium and high rating of low available nitrogen (266 to 271 kg ha^{-1}), medium in available phosphorus (39.15 to 40.35 kg ha^{-1}) and high in available potassium (615 to 645 kg ha^{-1}) in surface soil.

Table 1: Initial soil properties of experimental site

Sr. No	Particular	Values	Analytical method applied
1.	Texture	Clayey	
2.	$pH_{1:2.5}$	8.35 - 8.38	Potentiometric
3.	$EC_{1:2.5}$(dSm^{-1})	2.01 - 2.04	Conductometric
4.	Organic Carbon (%)	0.42 - 0.43	Walkley and Black's rapid titration method
5.	CEC [cmol(p+) kg^{-1}]	40.70 - 40	Flame photometric method
6.	ESP (%)	12.25 - 12.77	
7.	Available nitrogen (kg ha^{-1})	266 - 271	Alkaline KMnO4 method
8.	Available phosphorus (kg ha^{-1})	39.15 - 40.35	Olsen's, method
9.	Available potassium (kg ha^{-1})	615 - 645	Flame photometric method

Treatment details and design

The experiment was laid out in split plot design with four replications. The experiment comprising of twenty-seven treatment combinations consisting of three level of land configuration factor taken in main plot which are L_1: Flat bed, L_2: Broad bed furrow and L_3: ridge and furrow, while organic manures and fertilizer levels are taken in sub-plot treatment which are O_1: Control (without organic manure), O_2: FYM @ 10 t ha^{-1} and O_3:Bio-compost @ 10 t ha^{-1} as organic manure treatments and fertilizer level treatments were F_1:80% RDF(144-72-00 kg NPK ha^{-1}), F_2:100% RDF (180-90-00 kg NPK ha^{-1}) and F_3:120% RDF(216-108-00 kg NPK ha^{-1}).Treatments were allotted randomly within each replication.

Result and Discussion

Yield attributes and yield

The different levels of fertilizers remarkably influenced the yield attributes of wheat crop at harvest. Application of 120% RDF noted significantly highest in effective tillers m^{-1} row length (108 and 104.5), spike length (9.0 and 8.7 cm), spikelets $spike^{-1}$ (14.7, 12.1 cm) over remaining levels of fertilizer during both the years. The treatment F_1 (80% RDF) recorded the lowest number of effective tillers m^{-1} which were 101.5 and 97.94 during 1st and 2nd year respectively. The 120% RDF treatment significantly superior in case of spike length which recorded 9.0 and 8.7 cm during 2016-17 and 2017-18, respectively. The lowest spike length of 8.2 and 7.8 cm were noted in 80% RDF treatment.

The treatment F_3 (120% RDF) recorded significantly superior in spikelets $spike^{-1}$ (14.7 and 12.1) during 1st year and 2nd year, respectively). Application of 80 % RDF treatment recorded the lowest number of spikelets as 12.1 and 9.4 during 2016-17 and 2017-18, respectively. Significantly the highest grains $spike^{-1}$ were noticed during both the years. The lowest number of grains $spike^{-1}$ was observed from 80% RDF which recorded 27.2 and 26.9 during 1st and 2nd year, respectively. The increase in number of effective tillers in wheat crop due to more availability of major nutrients, which plays a vital role in cell division and ultimately adequate food supply to yield attributes. The results also get support from the findings of Kiani *et al.* (2005) [7], Usadadiya and Patel (2013) [5], Rahman *et al.* (2014) [10] and Bashir *et al.* (2015) [3]. Treatment F_3 (120% RDF) registered significantly higher test weight (42.53 and 41.62 g in 2016-17 and 2017-18, respectively), but it was remain at par with 100% RDF. In pooled results, 120% RDF recorded significantly the highest 1000 grain weight (42.08 g) than rest of fertilizer levels. The lowest test weight was recorded in 80% RDF which were 40.40 and 39.22g during 2016-17 and 2017-18, respectively. The application of 120% RDF (216+108+00 kg NPK ha^{-1}) treatment registered significantly the highest grain yield which were 4292 and 3499 kg ha^{-1} during 2016-17 and 2017-18, respectively than rest of fertilizer levels. Application of 120% RDF (216+108+00 kg NPK ha^{-1}) recorded significantly the highest the straw yield of wheat which were 5803 and 4843 during 1st and 2nd year, , respectively. The lowest straw yield (4404 kg ha^{-1}) was noted from 80% RDF (144+72+00 kg NPK ha^{-1}) during 2017-18. The increase in growth and yield owing to higher levels of major nutrients in terms of plant height and dry matter production, which resulted in adequate food supply to sink and ultimately reflected into better growth and yield attributes. These findings are in close agreement with those reported by Murtaza *et al.* (2000) [9] in rice, Kiani *et al.* (2005) [7], Mehdi *et al.* (2007) [8], Singh *et al.* (2007) [11], Gupta *et al.* (2011) [4], Jat *et al.* (2013) [5] and Kashyap *et al.* (2017) [6].

Nutrient uptake by plant

The data pertaining to nutrients uptake *i.e.*, nitrogen, phosphorus and potassium by wheat crop as influenced by different levels of fertilizer are presented in Table 3.

Significantly the highest total nitrogen (122.68 and 88.84 kg ha^{-1}), phosphorus (18.90 and 12.10 kg ha^{-1}) and higher potassium (157.81 and 126.99 kg ha^{-1}) uptake by wheat crop

were recorded in the treatment of higher dose *i.e.* 120% RDF (216+108+00 kg ha^{-1}) over rest of the treatments during 2016-17 and 2017-18, respectively. The lowest values of nitrogen, phosphorus and potassium uptake were 74.85, 9.39 and 116.88 kg ha^{-1} recorded in lower level of fertilizer treatment F_1 (144+72+00 kg NPK ha^{-1}) during 2017-18. This might be due to higher crop biomass production and better nourishment resulted into higher uptake of plant nutrients. Similar results were also reported by Murtaza *et al.* (2000) [9] and Jat *et al.* (2013) [5].

Table 2: Effect of different levels of fertilizer on yield attributes of wheat at harvest

Treatment	Number of effective tillers m^{-1}		Spike length (cm)		Number of spikelet spike^{-1}		Number of grains spike^{-1}	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
F_1:80% RDF (144-72-00 kg NPK ha^{-1})	101.5	97.90	8.2	7.8	12.1	9.4	27.2	26.9
F_2:100% RDF (180-90-00 kg NPK ha^{-1})	105.6	101.8	8.7	8.4	13.8	11.1	29.1	28.1
F_3:120% RDF (216-108-00 kg NPK ha^{-1})	108.1	104.5	9.0	8.7	14.7	12.1	29.6	28.7
S.Em.±	0.66	0.76	0.05	0.05	0.13	0.14	0.17	0.17
CD (P=0.05)	1.85	2.15	0.14	0.14	0.37	0.40	0.49	0.48

Table 3: Effect of different levels of fertilizer on yields and nutrient uptake by wheat crop

Treatments	Grain yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Nutrient uptake (kg ha^{-1})					
					N		P		K	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
F_1:80% RDF (144-72-00 kg NPK ha^{-1})	3892	3141	5446	4404	106.33	74.85	15.03	9.39	148.80	116.88
F_2:100% RDF (180-90-00 kg NPK ha^{-1})	4074	3328	5531	4626	114.77	82.94	17.06	11.07	153.69	124.44
F_3:120% RDF (216-108-00 kg NPK ha^{-1})	4292	3499	5803	4843	122.68	88.84	18.90	12.10	157.31	126.99
S.Em.±	26.04	20.50	50.02	50.51	1.01	0.73	0.16	0.10	1.80	1.68
CD (P=0.05)	73.41	57.81	141.03	142.41	2.84	2.08	0.45	0.29	5.07	4.74

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