RESEARCH ARTICLE

Study of Soil Nitrogen Level and Splitting on Nutrient Uptake around the Industries of Chhattisgarh, India

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For nitrogen analysis first and second soil samples were collected around the power plant and sponge iron plant of Siltara area, the third soil sample taken from crop area around rice mill of Bemetara district (India). Samples were collected from 15 cm. depth during post monsoon 2018. Result of chemical analysis of these samples indicates that the soil sample is found to be nitrogen deficient. Sample collected from 50 to 4500 meter around rice crop field. Available N content was raised continuously from 221.79 kg ha^{-1} (50 m) to 293.42 kg ha^{-1} (4500 m.) around sponge iron industry, 233.11 kg ha^{-1} (50 m) to 302.13 kg h^{-1} (4500 m) around power plant industry and 200.70 kg ha^{-1} at 50 m and 335.23 kg ha^{-1} at 4500 m around rice mill industry. This analysis is done by Nitrogen Auto Analyzer. Maximum value of nitrogen with phosphorus - potassium uptake observed in 150 kg of N ha^{-1} which is available in five split as 6S (10:10:10:20:05 at 11-13, 10, 30, 50, DAS & FL) and the concentration of higher soil available nitrogen also observed in 150 kg of N ha^{-1} described in following five split as 6S (10:10:10:20:05 at 11-13, 10, 30, 50, DAS & FL), maximum soil available phosphorus - potassium was observed in following three split as 1S (10:40:20 at 0, 20, 50 DAS) applied in 100 kg of N ha^{-1}.

Introduction

The soil is a main part of earth surface and play major role for the environments. Quality of soil is successfully showed by different ways like biological, chemical and physical method moreover organic matter of soil is very essential to perform function of soil and also a good indicator to improve its value. (Attoe *et. al.*, 2016). The development of technical and industrial improvement harmfully affects the environment by degrading and polluting the soil. Because of some industries the concentration of very important nutrients like Nitrogen decreases. Nitrogen is very important for the production of crops like rice and wheat (Waoo *et. al.*, 2014).

Rice (Oryza sativa L.) of Graminae family is very important crop for whole world with savour as a staple food by people of world. Asia Island occupies 85% of the total rice area. Inside total crop growing area of the world after wheat rice is the second most important crop as well as 40% population of all over the worlds consume rice for main energy. Nitrogen is the basic fertilizer for rice and it also help for high production of different varieties of rice (Banik *et. al.*, 1999).

Nitrogen is a crucial component of a lots of macronutrients which are essential for the development and growth of plant, stress responses and reproduction; it is an important component to build various compounds, as well as proteins (enzymes), plant hormones, chlorophyll, nucleic and amino acids (Comadira *et. al.*, 2015; Duan *et. al.*, 2007). In favor of biogeochemical process nitrogen fixation (NF) are accomplished, which is represented by the Nitrogen cycle. Nitrogen fixation process is used for the conversion of ammonia from nitrogen by photosynthetic N-fixing bacteria (NFB) also an intracellular nitrogenase enzyme system is used as a catalyst. In soil, mostly in plants NFB and rhizospheres naturally provide N for the development of crops. NFB can increase crop production while soil is N-deficient. For all bacteria Nitrogen is important nutrient, with top level of organic material within the atmosphere of soil (Ray *et. al.*, 2014; Olivares *et. al.*, 2013; Barua *et. al.*, 2012). Waste water effluents discharged from industries like rice mill contains elevated concentration of different types of material which caused considerable contaminating activities (Manogari *et. al.*, 2008). It is suggested that rice mill waste water should not be used as such for agricultural purpose. It plays an important role in soil pollution (Oleru 1984).

Plants use Nitrate (NO_3^- - N) and ammonium (NH_4^+-N) for growth and development which is the most important form of nitrogen. In root the absorption of these forms of inorganic nitrogen is possible via specific transport system. In the method of nitrate and nitrite reductase NO_3^--N converts to NO_2^--N and after that to NH_4^+-N (Valadier *et. al.*, 2008).

Nitrogen co-relates the complete food system from farm to mouth. For the production of food overdose of this nutrient causes problem. An uncontrolled nitrogen cycle can decrease the quality of soil, water and air pollution, loss of biodiversity and weak food system (Leip *et. al.*, 2020).

In case of human health, NO regulates blood pressure and vascular homeostasis. NO reacts with oxyhemoproteins, which produces methemoglobin and nitrate. In 1994, it is proved that NO is generated in the stomach by the acidic reduction (Bryan *et. al.*, 2013).

Methods

Study site

Present work was under taken out in surrounding area of a sponge iron plant and power plant which is about 20 km from the state capital Raipur, India and is in 81.6232°E longitude and 21.1967°W in Chhattisgarh, India and another sample is collected surrounding area of rice mill which is about 10 km from Bemetara district, India and is in 81.2849°E longitude and 21.1917°W latitude in Chhattisgarh, India. **Fig. 1** and **Fig. 2** show the map of Bemetara and Raipur district continuously. Usually, black soil is found at that area. Local name of black soil is Kanhar Mati.

Collection of samples

50 soil samples according to the norm AFNOR X31B were collected from the 15 cm upper layer at the 500m distance and soil content collected from all directions, in the month of December 2018. Beside this 2 sample each from the four directions was collected at 10 km distance as ideal samples. Collected soil sample were oven dried till 100 °C for 24 h and then sample will be ready for analysis of physico chemical properties, nutrients and heavy metal contents (Mason 1983).

Solution preparation

0.32% potassium permanganate, 2.5% Sodium hydroxide solution, 4% Boric acid and mixed indicator.

Procedure

Take 20 gm of dried soil sample in a distillation flask than add 25 ml (0.32%) of $KMnO_4$ with 25ml (2.5%) of NaOH. Other side 20 ml of 4% boric acid was mixed with indicator in a conical flask of 250 ml, liberated ammonia was absorbed in boric acid mixed with indicator. The Green colors attained from Pink colour. Simultaneous blank was also used.

Titration

Liberated ammonia ions were quantified in the receiving solution and the percentage of Nitrogen was calculated. The green colour achieved its original shade. Blank and soil sample titer reading be noted and the nitrogen content in soil was estimated.

Phosphorous nutrient

Phosphorous nutrient is analyzed by colorimeter and Potassium content is analyzed via flame photometer.

Fig. 1. Map of Bemetara District.

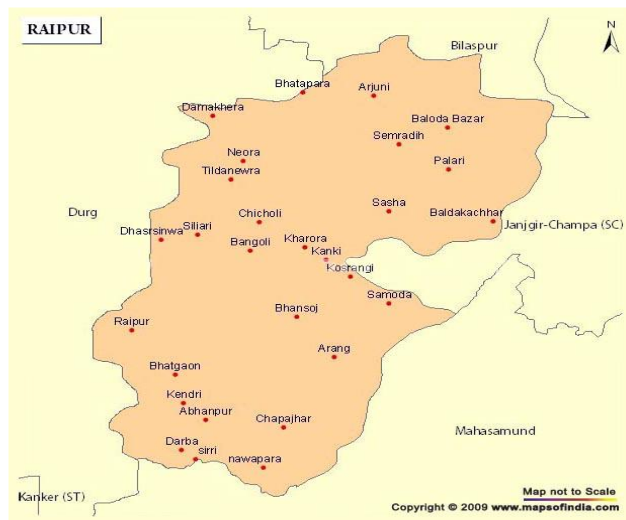

Fig. 2. Map of Raipur District.

Results and discussion

This paper shows the relation between agricultural land, food production and emitted reactive nitrogen (N). Nitrogen is a very important element for the growth of plant and an essential agricultural input. Fertility of soil depends upon the presence of nutrients in the surface soil although decreasing trend of available nitrogen content in the soil was observed with decreasing distance to the dust emission source (power plant), the influence of plant dust on available N content in soil was insignificant because of plant dust emission the available nitrogen content in soil was not influenced, considerably.

Although decreasing trend was observed as 293.42 kg ha^{-1} (4500 m) to 221.79 kg ha^{-1} (50 m). **Table 1** shows the Nitrogen concentration around sponge iron and **Fig. 3** shows the graphical representation of **Table 1**.

Distance in m	50	500	1000	1500	2000	2500	3000	3500	4000	4500
N kg h^{-1}	221.79	225.79	232.18	239.16	242.17	254.11	260.19	278.71	284.33	293.42

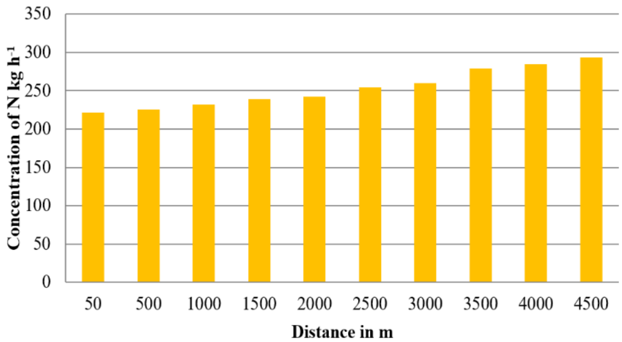

Fig. 3. Graphical representation of concentration of Nitrogen in Kg ha^{-1} around sponge iron industry.

The same result is also shown in the soil collected around power plant of Raipur District. Which indicate the decreasing trend was observed as 302.13 kg ha^{-1} (4500 m) to 233.11 kg ha^{-1} (50 m). **Table 2** shows the Nitrogen concentration around power plant and **Fig. 4** is the graphical representation of **Table 2**.

Table 2. Concentration of N in Kg ha^{-1} around power plant industry at various distance.

Distance in m	N kg ha^{-1}
50	233.11
500	245.16
1000	250.88
1500	256.99
2000	264.12
2500	270.19
3000	283.34
3500	289.44
4000	293.37
4500	302.13

Effluent obtained from rice mill contains basic nature and pH value differs from 7.2 ± 0.12 to 8.8 ± 0.07 (Pradhan *et. al.*, 2004). Nitrogen concentration around Rice Mill observed 200.70 kg ha^{-1} at 50 m and 335.23 kg ha^{-1} at 4500 kg ha^{-1}. It shows that the soil is nitrogen deficient which is as closer as Rice mill.

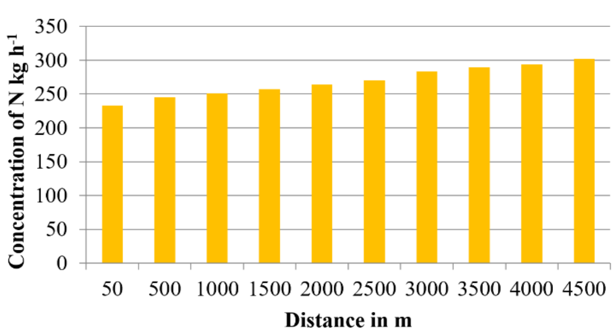

Fig. 4. Graphical representation of concentration of Nitrogen in Kg ha^{-1} around power plant industry.

Around Rice mill data of Nitrogen concentration and its graphical representation is shown in **Table 3** and **Fig. 5**.

Table 3. Concentration of N in Kg ha^{-1} around rice mill at various distance.

Distance in m	N kg ha^{-1}
50	200.70
500	236.87
1000	252.33
1500	279.13
2000	290.56
2500	307.98
3000	312.84
3500	321.53
4000	330.76
4500	335.23

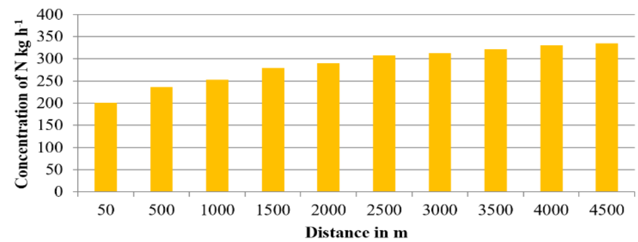

Fig. 5. Graphical representation of concentration of Nitrogen in Kg ha^{-1} around rice mill industry.

Due to deficiency of N in soil the crop yield around the factory decreased around the source. The accessibility of nitrogen is not only an important part of fats, oils and carbohydrates, but also an essential component of proteins. Available nitrogen is a very important factor to increase the fertility of soil. Generally, normal soil contains 280 – 560 kg ha^{-1} of available nitrogen. Uniform yellowing of older leaves including veins, leaves shows the deficiency of nitrogen that will eventually turn brown and die. The dark green color of plant shows excess of nitrogen.

Nitrogen uptake around power plant industry of Chhattisgarh

Uptake of Nitrogen is increased by the increasing level of the Nitrogen by rice. Data shown in **Table 4** indicates the application that except 30 DAS high nitrogen uptake found 150 kg N ha^{-1} at all stages. Considerably 100 kg N ha^{-1} recorded as lowest nitrogen uptake. Nitrogen application at 12 DAS as high level of nitrogen is recorded. At 20 DAS, high level of N kg ha^{-1} like basic use of N was found at particular split level. It is compared that nitrogen splitting recorded in five splits 6S (10:10:10:20:05 at 11-13, 10, 30, 50, DAS & flowering) is obtained high level of N.

Uptake compare to another split of nitrogen application at various stages excluding 20 DAS. At 20 DAS 3S (10:15:15:20 at 0, 10, 30, 50 DAS) is obtained as high level of N uptake. Under three splitting level of nitrogen the lowest nitrogen uptake is recorded 1S (10:40:20 at 0, 20, 50 DAS). Application of N in different splitting on the basis of crop necessity may reduce the nitrogen loss and also increased the absorption of nitrogen consequently for the more consumption of used nitrogen. Accumulation of high level of dried substances leads and higher nitrogen uptake concluded.

Table 4. Nitrogen levels and its splitting in kg ha^{-1} by rice at various developing stages was observed at post-monsoon.

Treatment	Nitrogen uptake (kg ha^{-1})					
	20 DAS	50 DAS	80 DAS	Grain	Straw	Total
Nitrogen level (kg ha^{-1})						
N1-100	2.01••	8.74	36.70	31.56	8.45	19.00
N2-125	2.39••	11.36	48.65	38.56	12.49	24.52
N3-150	2.81••	12.69	54.96	45.62	15.51	29.56
SEM	1.01•	1.17•	1.92•	1.67•	1.23•	1.45•
CD (P=0.05)	1.09••	1.71•	4.64•••	3.66	1.93•	1.79••
Nitrogen splitting						
1S – 3 Split (10:40:20 at 0, 20, 50 DAS)	2.08••	9.41	39.57	33.74	9.51	20.62
2S – 3 Split (10:40:20 at 11-13, 20, 50 DAS)	1.96•	9.75	41.92	35.20	9.92	21.56
3S – 4 Split (10:15:15:20 at 0,10,30,50 DAS)	2.87••	10.78	46.57	37.16	11.84	23.5
4S – 4 Split (10:15:15:20 at 11-13, 30, 50, 70 DAS)	2.66••	11.25	48.40	39.63	12.67	25.15
5S- 5 Split (10:10:10:20:0 5at 0, 10, 30, 50 DAS & FL)	2.52••	11.89	51.00	41.62	13.88	26.75
6S- 5 Split (10:10:10:20:05 at 11-13, 10, 30, 50 DAS & FL)	2.32••	12.49	53.15	44.13	15.06	28.59
SEM	1.04•	1.29•	3.51•••	2.06••	1.39•	0.72•
CD (P=0.05)	1.15•	1.86•	8.29	4.00••	2.17	2.08••

DAS = Days after sowing: FL = Flowering
•P <0.05, •P <0.01, •P <0.001

Uptake of phosphorus and potassium

Data in **Table 5** shows that phosphorus and potassium uptake of rice increased by increasing levels of nitrogen. Considerably result is obtained from 150 kg N ha^{-1} as high phosphorus - potassium uptake. Significantly lowest uptake of phosphorus - potassium was calculated in less than 100 kg N ha^{-1}. Basic application of nitrogen is higher phosphorus and potassium uptake is reported at 10 DAS. The comparison between splitting of nitrogen reported that uptake of higher phosphorus and potassium exhibit application of nitrogen in significantly five splits 6S (10:10:10:20:05 at 11-13, 10, 30, 50, DAS & FL). The three splitting of N (1S- 10:40:20 at 0, 20, 50 DAS) and (2S- 10:40:20 at 11-13, 20, 50 DAS) shows low level of phosphorus - potassium uptake.

Table 5. Nitrogen levels and Phosphorus - Potassium splitting uptake in kg h^{-1} by rice observed at post-monsoon.

Treatment	Nitrogen uptake (kg ha^{-1}) Phosphorous Potassium					
	Grain	Straw	Total	Grain	Straw	Total
Nitrogen level (kg ha^{-1})						
N1-100	14.76	8.57	22.33	22.80	60.97	82.77
N2-125	16.54	9.36	24.90	24.12	70.84	93.96
N3-150	18.88	10.59	28.47	25.54	92.73	117.27
SEM	1.34•	1.22•	1.56•	1.13•	1.90•	1.03••
CD (P=0.05)	2.37	1.91•	2.28	1.57•	4.57••	4.14••
Nitrogen splitting						
1S – 3 Split (10:40:20 at 0, 20, 50 DAS)	14.37	8.67	22.04	21.75	62.36	83.11
2S – 3 Split (10:40:20 at 11-13, 20,50 DAS)	15.46	9.07	23.53	23.09	69.26	91.35
3S – 4 Split (10:15:15: 20 at 0,10,30,50 DAS)	16.32	9.11	24.43	22.97	72.17	94.14
4S – 4 Split (10:15:15: 20 at 11-13, 30, 50, 70 DAS)	17.39	9.64	26.03	23.96	76.02	48.99
5S- 5 Split (10:10:10: 20:05 at 0, 10, 30, 50 DAS & FL)	17.72	9.93	26.65	25.15	81.74	105.89
6S- 5 Split (10:10:10: 20:05 at 11-13, 10, 30, 50 DAS & FL)	19.10	10.64	28.74	28.02	87.54	114.56
SEM	1.49•	1.27•	1.76•	1.51•	3.40••	3.91••
CD (P=0.05)	2.43•	1.82•	2.26••	2.52•	7.97	9.49

DAS = Days after sowing: FL = Flowering
•P <0.05, •P <0.01, •P <0.001

Available soil nutrient

Available nitrogen

Data on **Table 6** represents that soil available nitrogen increased by increasing levels of nitrogen. Higher level of soil available nitrogen (243.79 kg ha^{-1}) is applied with 150 kg of N ha^{-1}. Low amount of soil nitrogen (238.80 kg ha^{-1}) obtained under 100 kg of N ha^{-1}. High level of soil nitrogen (278.22 kg ha^{-1}) is recorded in given five splits (6S-10:10:10:20:05 at 11-13, 10, 30, 50, DAS & FL). Under three nitrogen splits as (1S-10:40:20 at 0, 20, 50 DAS) the lowest value of soil available nitrogen (253.03 kg ha^{-1}) was found. Available soil nutrients like available nitrogen, phosphorous and potassium is given in **Table 6**.

Table 6. Nitrogen levels with nitrogen and phosphorus - potassium splitting at post-monsoons.

Treatment	Soil available nutrients (kg ha^{-1})		
	Nitrogen	Phosphorous	Potassium
Nitrogen level (kg ha^{-1})			
N1-100	238.80	30.25	280.71
N2-125	240.33	20.61	269.66
N3-150	243.79	18.25	263.06
SEM	2.66••	1.39•	1.88•
CD (P=0.05)	7.92•••	2.21••	4.35••
Nitrogen splitting			
1S – 3 Split (10:40:20 at 0, 20, 50 DAS)	253.03	30.85	281.63
2S – 3 Split (10:40:20 at 11-13, 20,50 DAS)	256.66	30.05	277.04
3S – 4 Split (10:15:15:20 at 0,10,30,50 DAS)	261.45	20.73	273.09
4S – 4 Split (10:15:15:20 at 11-13, 30, 50, 70 DAS)	268.37	20.22	270.33
5S- 5 Split (10:10:10:20:05 at 0, 10, 30, 50 DAS & FL)	273.44	19.66	265.78
6S- 5 Split (10:10:10:20:05 at 11-13, 10, 30, 50 DAS & FL)	278.22	18.57	266.33
SEM	6.21•••	1.33•	5.91•••
CD (P=0.05)	20.11	2.13	15.21

DAS = Days after sowing: FL = Flowering
•P <0.05, •P <0.01, •P <0.001

Available soil phosphorus and potassium

Data shown in **Table 6** represents to the soil available phosphorus and potash decreased by the increasing levels of nitrogen. Application of the 100 kg of N ha^{-1} showed maximum value of phosphorus – potassium in soil. Considerably 150 kg of N ha^{-1} is lowest soil available value of phosphorus and potassium was observed. The comparison of splitting of nitrogen shows that higher soil available phosphorus and potash reported by the following three splits 1S (10:40:20 at 0, 20, 50 DAS), 2S (10:40:20 at 11-13, 20, 50 DAS) and 3S (10:15:15:20 at 0, 10, 30, 50 DAS). Under six splitting of nitrogen 6S (10:10:10:20:05 at 11-13, 10, 30, 50, DAS & FL) the lowest soil available value of phosphorus and potassium was observed.

Conclusion

In the Indian economy agriculture is a major sector, which is highly affected by changing trends in, insufficient water, agriculture practices, temperature, rainfall and nutrient deficiencies. Deficiency of soil nitrogen is reported while organic matter is mixed to soil in the form of discharged carbon dust from various industries present around crop land. Micro-organism presents in soil uses soil available nitrogen to break the carbon content, which makes unavailability of nitrogen in soil. Sufficient soil parameters and proper use of fertilizers may help to solve these problems. The recent research supports the Indian Government to make decision to improve quality of soil and also crop production.

Nitrogen plays an important role for plants and animals. It is improved by the awareness of the farmers and skilled for the valuable advantages of nitrogen. Improper use of nitrogen causes limited crop yield and lower quality of crop. Management of N is essential for crop production. Soil test and analysis report suggested the quantity of N to be applied.

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Keywords

Sample, field, rice, raise, industry, nitrogen auto analyzer, collected.

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