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ORIGINAL ARTICLE **OPEN ACCESS**

GPS and GIS Based Nutrient Status Assessment and Mapping of Mulberry Growing Areas in Anantapur District of Andhra Pradesh

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ABSTRACT

The purpose of the present study is to assess soil fertility status and mapping of available nutrients in mulberry growing areas of Dharmavaram, Bathalapalli, Ramagiri, and C.K. Pallimandals in Anantapur district by using GPS and GIS techniques. The selected area is situated in Latitudes between 14°35'30" and 14°13'30" N and Longitude between 77°20'0" and 77°50'0" E. In the study area 30 georeferenced soil samples were collected from 13 selected mulberry growing villages in Anantapur district. A GPS device was used for the determination of global position of soil sampling points and the GPS readings were used for the preparation of soil fertility maps by using GIS. The collected soil samples were analysed for pH, OC, EC, N, P, K, Cu, Mn, Fe and Zn. The soil fertility maps clearly revealed that a major selected mulberry growing area was slightly alkaline to alkaline in reaction. The OC status of the soil (83.3%) samples was under low status and (16.7%) samples recorded medium in condition. With regard to the electrical conductivity of the soil recorded as medium, high to very high in condition. The available nitrogen was generally low in all collected samples. The available phosphorous in majority of (63.4%) samples were recorded high and (33.3%) samples were medium, (3.3%) samples were low. Available potassium content (53.4%) was high and (26.6%) samples recorded medium and only (20%) samples recorded low in reaction. It is evident from the present results that micronutrients such as Cu (93.4%) and Fe (86.7%) were deficient when compared to the proportions of Zn and Mn. Ananatapur is one of the leading districts in the production of silk in Andhra Pradesh. Sericulture is one of the major agro based industry which has high potential in rural development. Since mulberry is the major food source of silkworm Bombyxmori L the growth, development and quality of leaf plays the major role in quality and quantity of silk production. Hence the maintenance of balanced nutrient status in mulberry soils is must for the production of quality leaf. In this context the present investigation is carried out to know the soil fertility status through mapping which helps in suggesting the farmer's better soil management for successful sericulture.

Keywords: *GPS and GIS techniques, soil fertility maps, GPS readings, Mulberry.*

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INTRODUCTION

Soil fertility refers to the available nutrients present in the soil which supply nutrients to plants in required proportions. Hence the continuous monitoring the soil fertility status is very essential for maximum crop growth and production. The crop growth, development and getting better yield depends on the available nutrients present in the soil in sufficient levels. Inadequate presence of nutrients in soil leads to stunted growth and development of plants and such nutrient deficiency plants shows deficiency symptoms and yield will be reduced and such nutrient deficiency can de prevent by applying the required nutrients in suitable proportion. Hence the application of balanced fertilizers results better yield.

The actual fertility status of soils has to be identified before crop production which will help to manage the soil nutrient status in that particular crop. The GPS and GIS helps in collecting a systematic set of georeferenced samples and generating spatial data about the distribution of nutrients [1]. Georeferenced maps also help in monitoring changes in nutrient status over a period of time by revisiting with the help of GPS [2].

GIS can be useful to prepare soil fertility maps of an area that will help to assess soil fertility status temporally such soil fertility maps gives information about fertilizer recommendation and sustainable crop management. Therefore, the present study was conducted to assess the status of soil fertility by developing fertility mapping of mulberry soils in Dharmavaram, Bathalapalli, Ramagiri, and C.K. Palli of Anantapur district.

STUDY AREA

The selected study areas for this research includes the Dharmavaram, Bathalapalli, Ramagiri, and C.K. Pallimandals in Anantapur district by using GPS and GIS techniques.

The selected area is situated in Latitudes between 14°35'30'' and 14°13'30" N and Longitude between 77°20'0" and 77°50'0" E. In the study area 30 georeferenced soil samples were collected from 13 selected mulberry growing villages in Anantapur district.

OBJECTIVES

The main objectives of the present study are

1) To know soil fertility status in selected mulberry growing areas.
2) To know the impact of fertilizers in soil.
3) To make awareness to farmers about soil fertility management through soil test.
4) To know sufficiency and deficiency areas by soil fertility mapping.

MATERIALS AND METHODS

In the study area a total of 30 soil samples were collected from 13 villages in Anantapur district of Andhra Pradesh.

Soil sampling method

The collected soil samples from the study sites were air dried, ground with wooden pestle and mortar and they were passed through 2mm sieve. Then the samples were labeled carefully and stored until further analysis.

The processed samples were subjected 10 different chemical reactions to assess the soil quality. pH and Electric conductivity, available potassium was assessed by following the method of Jackson [3].

For the estimation of organic carbon and available nitrogen the methods of [4, 5] was used. Estimation of total available phosphorus the method of Bray and Kurtz [6] was used. Lindsay and Norvell [7] method was employed for the estimation of available micronutrients such as Cu, Mn, Fe and Zn.

RESULTS AND DISCUSSION

Management of optimum soil pH is very much essential to get the better crop production. The given table 1 reveals that soil fertility status in the study area indicated that 28(93.4%) samples recorded alkaline and only 2(6.6%) samples were found to be slightly alkaline (Figure 1).

The high pH of soil might be due to higher degree of base saturation [8, 9]. The electrical conductivity of the soil recorded 23(76.7%) samples medium and 4(13.3%) samples was under high status. And only 3(10%) sample recorded very high (Figure 2).

The overall percent sample category of O.C. revealed that 25(83.3%) samples were under low status and 05(16.7%) samples recorded medium category (Figure 3).

The low organic matter is due to high temperature leading to higher rate of organic matter decomposition [10] and also due to little or no organic matter additions [11].

The given table revealed that percent sample category of N, P, K status indicates that the available nitrogen content in out of 30 samples in 13 villages all the 30(100%) samples recorded low (Figure 4). This may be due to low rainfall, low organic matter and alkaline soils which leading to low nitrogen content in the soils may be one of the reasons.

The phosphorous status in the soil was out of 30 samples 19(63.4%) samples was recorded high and 10(33.3%) samples medium and only one sample recorded low in condition (Figure 5).

It is evident from the study that the phosphorous deficiency was very little in the study soil sampling sites. The high level of phosphorous might be due to continues application of phosphate fertilizers. The available potassium status in the soil fertility map of study area shows that 16(53.4%) samples was found to be high and 8(26.6%) samples recorded low and only 6(20.6%) was under low status (Figure 6). It is evident from the study findings that only few areas recorded potassium deficiency.

Table 1. Soil fertility status from the selected study sites

S/N	Soil Parameters	Percent Sample Category					
		Low/Acidic		Medium/Neutral		High/Alkaline/Slightly Alkaline/Very High	
		No. of samples	%	No. of samples	%	No. of samples	%
1	pH	00	0.0	00	0.0	Alkaline	
						28	93.4
						Slightly alkaline	
						02	6.6
2	Electrical conductivity (EC)	00	0.0	23	76.7	Very high	
						03	10
						High	
						04	13.3
3	Organic carbon (OC)	25	83.3	05	16.7	00	0.0
4	Available N	30	100	00	0.0	00	0.0
5	Available P	01	3.3	10	33.3	19	63.4
6	Available K	06	20	08	26.6	16	53.4

(Acidic, neutral, alkaline/slightly alkaline for pH; Low medium and high for OC, N, P, K and very high for E.C).

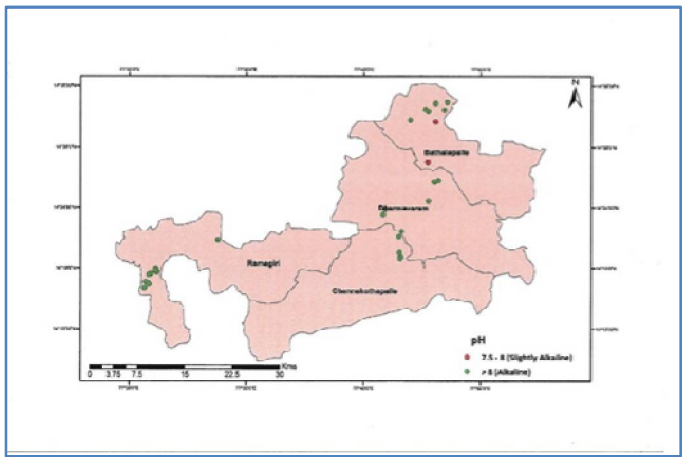

Figure 1. Soil fertility mapping of pH

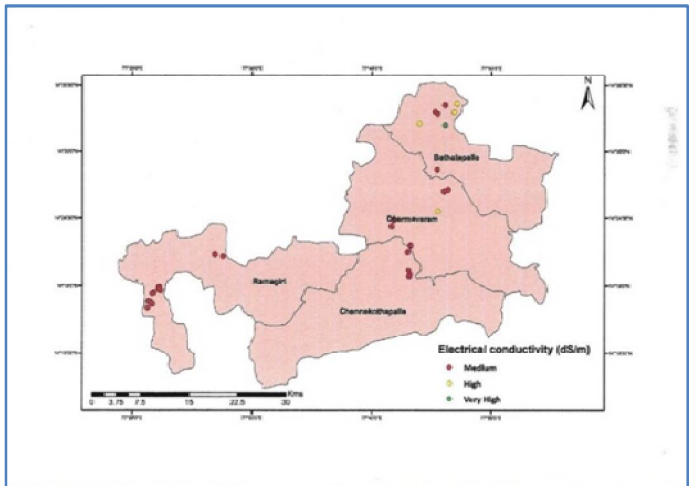

Figure 2. Soil fertility mapping of Electrical Conductivity

Table 2. Soil fertility status of micronutrients in selected mulberry growing areas of Dharmavaram, Bathalapalli, Ramagiri, C.K. Pallimandals of Anantapur district

S/N	Soil Parameters	Percent Sample Category			
		Deficient		Sufficient	
		No of samples	%	No of samples	%
1	Available Copper	28	93.4	02	6.6
2	Available Manganese	00	0.0	30	100
3	Available Iron	26	86.7	04	13.3
4	Available Zinc	00	0.0	30	100

Table 2 revealed the percentage availability of micronutrients form the selected study sites. The copper deficient is more predominant nearly (93.4%) samples were characterized by deficient and only (6.6%) samples was sufficient in condition (Figure 7), which might be due to low O.C. and alkaline pH. With regard to iron status (86.7%) samples was noticed deficient, only (13.3%) samples sufficient in condition (Figure 8). Particularly copper and iron deficiency soils reported widely in many villages. It is evident from the study that the manganese and zinc availability is in high proportions in all soil samples form the selected villages (Figure 9 & 10).

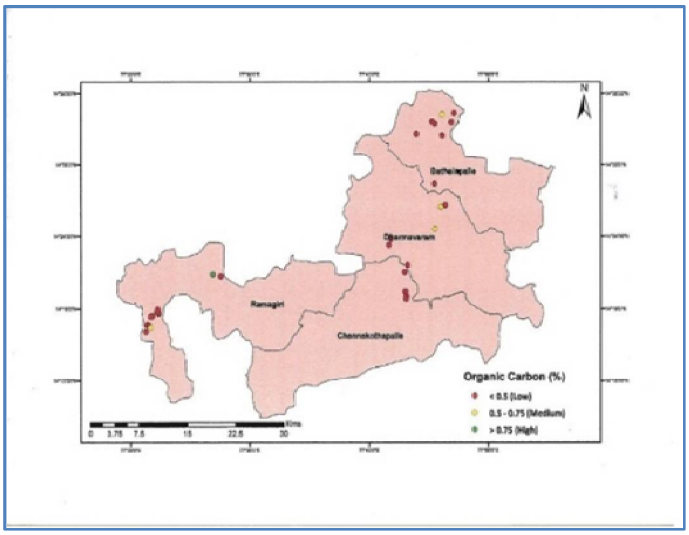

Figure 3.Soil fertility mapping of O.C.

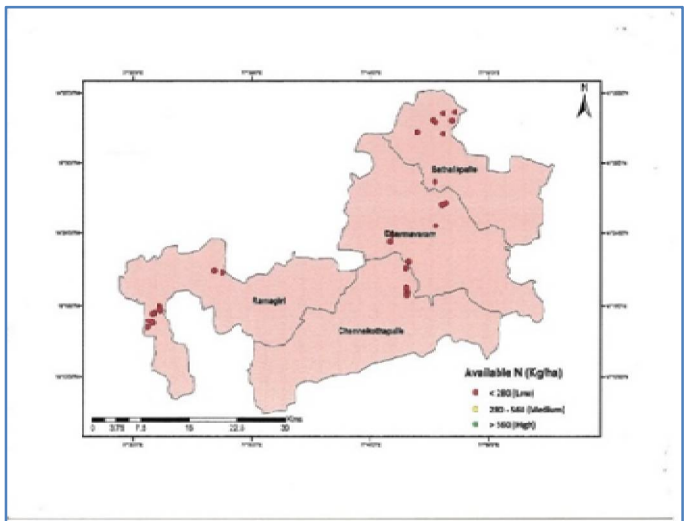

Figure 4. Soil fertility mapping of available nitrogen

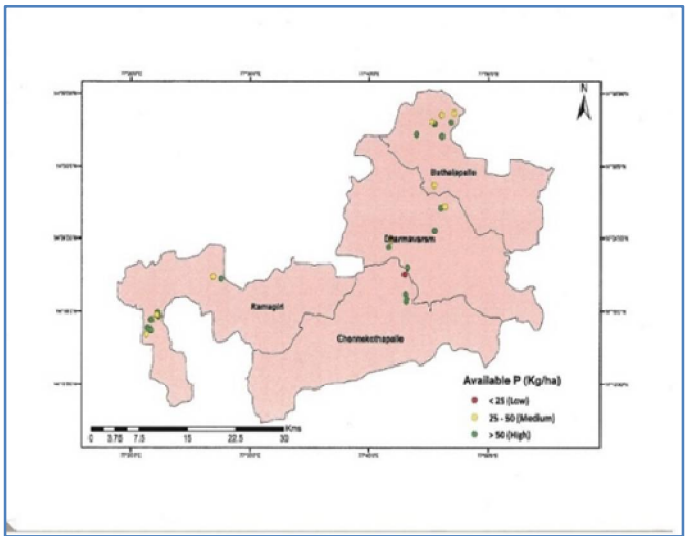

Figure 5. Soil fertility mapping of available phosphorous

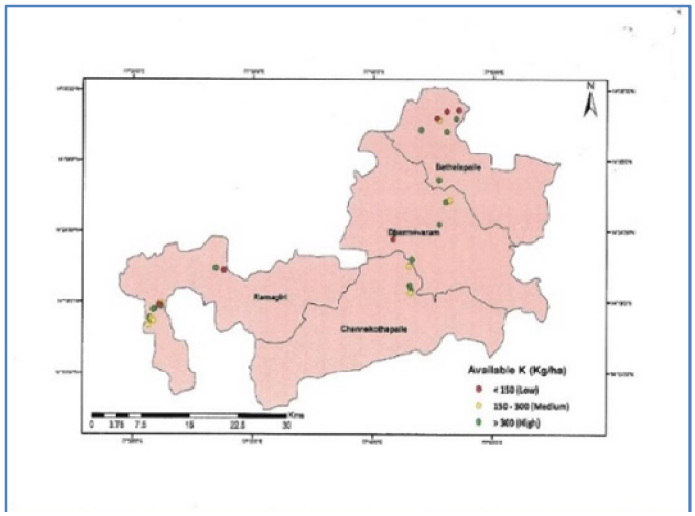

Figure 6. Soil fertility mapping of available potassium

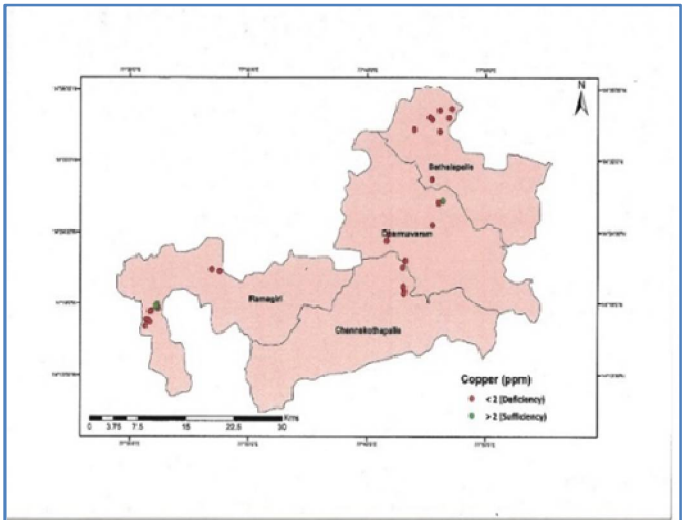

Figure 7. Soil fertility mapping of available Copper

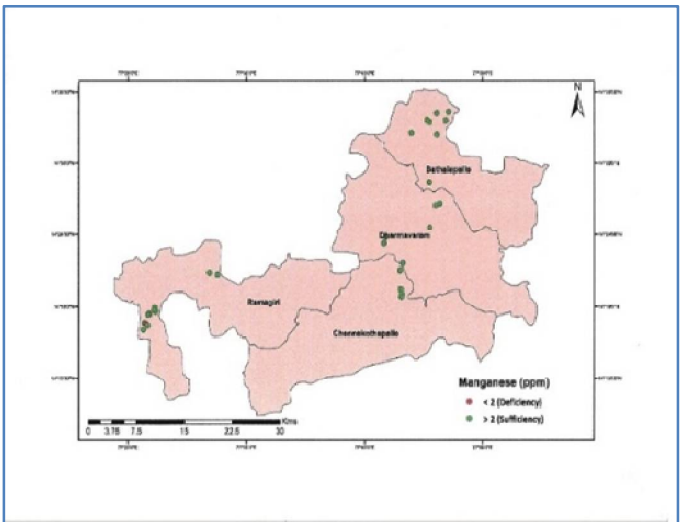

Figure 8. Soil fertility mapping of available Manganese

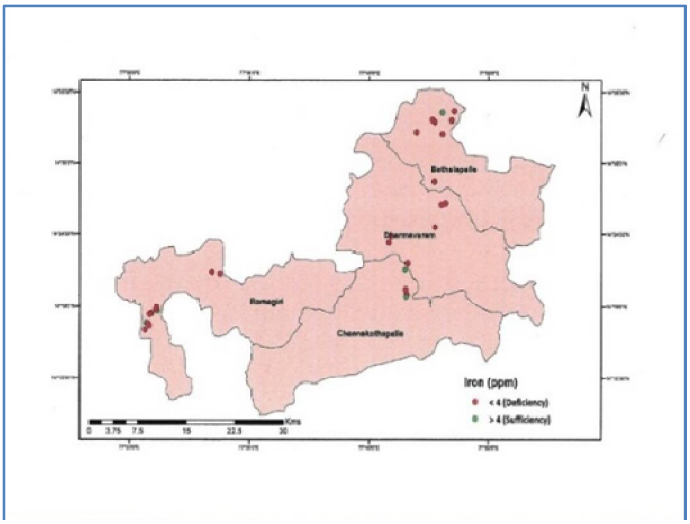

Figure 9. Soil fertility mapping of available Iron

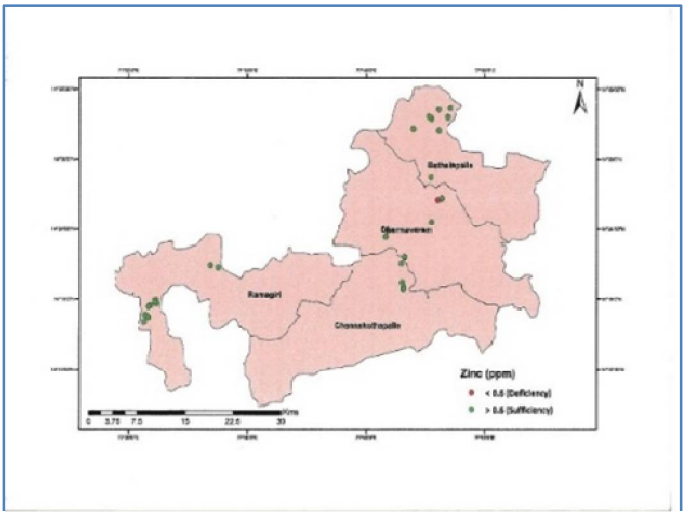

Figure 10. Soil fertility mapping of available Zinc

Table 3. Distribution of soil samples based on soil fertility maps in Dharmavaram, Bathalapalli, Ramagiri, C.K. mandals of Anantapur district.
Bray-P; L (Low), M (Medium), H (High), V.H (Very High)

S/N	Village Name	pH			EC				OC		
		Acidity	Neutral	Alkaline/Slightly alkaline	L	M	H	V.H	L	M	H
1	Pothulangapalli	0	0	2	0	2	0	0	2	0	0
2	Regatipalli	0	0	2	0	2	0	0	2	0	0
3	Thummala	0	0	3	0	2	0	1	1	2	0
4	Malyavantham	0	0	3	0	1	2	0	2	1	0
5	Mushturu	0	0	1	0	0	1	0	1	0	0
6	Ananthasagaram	0	0	2	0	1	1	0	2	0	0
7	Venkatagaripalli	0	0	1	0	0	0	1	1	0	0
8	Velupumadugu	0	0	2	0	1	0	1	2	0	0
9	Gangampalli	0	0	2	0	2	0	0	1	1	0
10	Makkinavaripalli	0	0	3	0	3	0	0	3	0	0
11	Chinnakondapuram	0	0	2	0	2	0	0	2	0	0
12	Peddakondapuram	0	0	4	0	4	0	0	3	1	0
13	Medapuram	0	0	3	0	3	0	0	3	0	0
	Total	00	00	30	0	23	04	03	25	05	00

Table 4. Distribution of soil samples based on the soil fertility maps in Dharmavaram, Bathalapalli, Ramagiri, C.K. pallimandals of Anantapur district.
Bray-P; L (Low), M (medium), H (High), for macronutrients. S (Sufficient), D (Deficient) for micronutrients.

S/N	Name of the Village	Nitrogen			Phosphorous			Potassium		
		L	M	H	L	M	H	L	M	H
1	Pothulangapalli	2	0	0	1	0	1	0	1	1
2	Regatipalli	2	0	0	0	1	1	1	0	1
3	Thummala	3	0	0	0	1	2	0	1	2
4	Malyavantham	3	0	0	0	2	1	2	0	1
5	Mushturu	1	0	0	0	0	1	0	0	1
6	Ananthasagaram	2	0	0	0	1	1	1	1	0
7	Venkatagaripalli	1	0	0	0	0	1	0	0	1
8	Velupumadugu	2	0	0	0	1	1	0	0	2
9	Gangampalli	2	0	0	0	1	1	1	0	1
10	Makkinavaripalli	3	0	0	0	1	2	1	1	1
11	Chinnakondapuram	2	0	0	0	1	1	0	0	2
12	Peddakondapuram	4	0	0	0	1	3	0	3	1
13	Medapuram	3	0	0	0	0	3	0	1	2
	Total	30	00	00	01	10	19	06	08	16

S/N	Name of the Village	Copper		Manganese		Iron		Zinc	
		S	D	S	D	S	D	S	D
1	Pothulangapalli	0	2	2	0	1	1	2	0
2	Regatipalli	0	2	2	0	0	2	2	0
3	Thummala	1	2	3	0	0	3	3	0
4	Malyavantham	0	3	3	0	1	2	3	0
5	Mushturu	0	1	1	0	0	1	1	0
6	Ananthasagaram	0	2	2	0	0	2	2	0
7	Venkatagaripalli	0	1	1	0	0	1	1	0
8	Velupumadugu	0	2	2	0	0	2	2	0
9	Gangampalli	0	2	2	0	0	2	2	0
10	Makkinavaripalli	1	2	3	0	1	2	3	0
11	Chinnakondapuram	0	2	2	0	0	2	2	0
12	Peddakondapuram	0	4	4	0	0	4	4	0
13	Medapuram	0	3	3	0	1	2	3	0
	Total	02	28	30	00	04	26	30	00

CONCLUSION

It is evident from the present study that the soil fertility maps helps in better management of soil nutritional parameters. A majority of soil samples were alkaline, organic carbon status was predominantly low. E.C. was medium in condition, whereas the available nitrogen was observed low in status. With regard to phosphorous and potassium the soil conditions were low and medium to high in reaction respectively. The percentage of manganese and zinc is in high proportions in all soil samples form the selected villages of Anantpur district of Andhra Pradesh.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest for this study.

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