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Chlorophyll meter (SPAD) based nano urea fertilization in maize (*Zea mays* L.)

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Abstract

The present investigation entitled, “Chlorophyll meter (SPAD) based nano urea fertilization in Maize (*Zea mays* L.)” was conducted at the Department of Agronomy farm, school of Agriculture, LPU during *Kharif* season 2021. The soil was sandy with pH 7.9 indicating slightly alkaline in reaction, sandy in texture and slightly alkaline in reaction, with low levels of organic carbon, available nitrogen, phosphorus, and potassium.

The Experiment conducted in Randomized Block Design with T₁ Absolute control), T₂- 2% Urea spray, T₃- 100% RDF (125: 60: 30 kg N: P₂O₅: K₂O), T₄- SPAD threshold 36-40 with nano urea spray @ 2 ml/l, T₅- SPAD threshold 36-40 with nano urea spray @ 4 ml/l, T₆ - SPAD threshold 36-40 with nano urea spray @ 6 ml/l, T₇- SPAD threshold 41-45 with nano urea spray @ 2 ml/l, T₈- SPAD threshold 41-45 with nano urea spray @ 4 ml/l, T₉- SPAD threshold 41-45 with nano urea spray @ 6 ml/l, T₁₀- SPAD threshold 46-50 with nano urea spray @ 2 ml/l, T₁₁- SPAD threshold 46-50 with nano urea spray @ 4 ml/l, T₁₂- SPAD threshold 46-50 with nano urea spray @ 6 ml/l. There were twelve treatments replicated thrice.

The results of the study indicated that foliar application of SPAD threshold 46-50 with nano urea spray @ 6 ml/l recorded higher growth, yield attributing characters and quality. GMR, NMR and B: C ratio were significantly higher in the treatment SPAD threshold 46-50 with nano urea spray @ 6 ml/l.

Keywords: Chlorophyll meter, SPAD, nano urea fertilization, *Zea mays* L.

Introduction

India is fourth in terms of area and seventh in output among maize-growing countries, accounting for around 4% of the global maize area and 2% of total production. In India, the maize acreage increased to 9.2 million hectares in 2018-19. (DACNET, 2020). Since 2010, India's maize production has increased at a rate of nearly 50 kg/ha/year, the highest among food crops. Madhya Pradesh and Karnataka have the most area under maize (15%) among Indian states, Maharashtra (ten percent), Rajasthan (nine percent), Uttar Pradesh (eight percent), and other states follow. Bihar produces the most maize after Karnataka and Madhya Pradesh. The state with the highest production in Andhra Pradesh. Like Krishna and West Godavari, some districts have production levels as high as 12 t/ha. The majority of maize produced in India is utilised as chicken feed (about 47 percent). The remaining product is divided into 13 percent for animal feed and food, 12 percent for industrial usage, 14 percent for the starch sector, 7% for processed food, and 6% for export and other uses. (Agaie *et al.*, 2020) [1].

Foliar feeding is the practice of distributing liquid fertiliser directly to the leaves of plants. Plants can acquire vital nutrients through their leaves. Their stomata and epidermis are both used for absorption. Foliar spray is the application of nutrients to the crop's leaves in the form of a spray solution. (Hegab 2018) [5] This approach is ideal for applying modest amounts of fertilisers, particularly micronutrients. When the top layer of soil is dry, this procedure can also be used to provide major fertilisers. Foliar application is a complement to soil treatment, not a replacement. Foliar feeding has lately become generally regarded as an important aspect of crop productivity, particularly in horticultural crops. The benefits of foliar feeding have been widely recognised. Growing attempts have been made to get consistent responses on agronomic crops, even though it is not as ubiquitous. Nano urea is a liquid nitrogen fertilizer that is mainly required for the proper growth and development of crops. It has been developed at IFFCO Nanobiotechnology Research center, Gujarat. Nano urea reduces the application bulk nitrogenous fertilizer by up to 50%. Due to its foliar application, it will successfully fulfill the demand of Nitrogen in the soil and crops. (El- Gizaway, N. 2019) [4]

Material and Methods

The present investigation entitled, "Chlorophyll meter (SPAD) based nano urea fertilization in Maize (*Zea mays* L.)" was conducted at the Department of Agronomy farm, school of Agriculture, LPU during *Kharif* season 2021. The soil was sandy with pH 7.9 indicating slightly alkaline in reaction, sandy in texture and slightly alkaline in reaction, with low levels of organic carbon, available nitrogen, phosphorus, and potassium.

The Experiment conducted in Randomized Block Design with T₁ Absolute control), T₂- 2% Urea spray, T₃- 100% RDF (125: 60: 30 kg N: P₂O₅: K₂O), T₄- SPAD threshold 36-40 with nano urea spray @ 2 ml/l, T₅- SPAD threshold 36-40 with nano urea spray @ 4 ml/l, T₆ - SPAD threshold 36-40 with nano urea spray @ 6 ml/l, T₇- SPAD threshold 41-45 with nano urea spray @ 2 ml/l, T₈- SPAD threshold 41-45 with nano urea spray @ 4 ml/l, T₉- SPAD threshold 41-45 with nano urea spray @ 6 ml/l, T₁₀- SPAD threshold 46-50 with nano urea spray @ 2 ml/l, T₁₁- SPAD threshold 46-50 with nano urea spray @ 4 ml/l, T₁₂- SPAD threshold 46-50 with nano urea spray @ 6 ml/l. There were twelve treatments replicated thrice.

The crop variety DKC 9164 was used with spacing of 60cm x 20 cm. gross plot size was 5m x 4m. full dose of phosphate and potassium applied as basal dose and N was applied through nano urea spray at 25 DAS. Five plants of maize from each net plot were selected randomly *viz.*, Plant height (cm), number of leaves plant⁻¹, leaf area plant⁻¹, leaf area index, recorded at 30, 60, 90 and harvest.

Yield attributing characters *viz.*, No. of cobs plant⁻¹, number of grains cob⁻¹, seed index (g), grain and straw yield (kg ha⁻¹) were recorded at harvest. The GMR, NMR and B: C ratios were calculated.

Results and Discussion

A. Effect of nano urea on growth attributes

The result of the study indicated that application of treatment SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) gave significantly higher plant height, stem girth, no. of functional leaves plant⁻¹, found statistically at par with SPAD threshold 41-45 with nano urea spray @ 6 ml/l (T₉) and SPAD threshold 36-40 with nano urea spray @ 6 ml/l (T₆). This might be due to nitrogen play important role in cell metabolism, cell division and cell enlargement that increase in Plant height (cm), number of leaves plant⁻¹, leaf area plant⁻¹, leaf area index. According to cheenu kashyap (2022) [2] application leaf colour chart threshold 5 with nano urea 6ml/l recorded higher growth attributes. Similar result recorded by dhlamini *et al.*, (2020) [3]. According to Rathnayaka *et al.* (2018) [8] observed that the application of 100% Nano-Nitrogen fertilizer had given the highest growth performance about plant height (57.9cm), several tillers per plant (6), and plant dry weight during the ripening stage (9.9g). About yield (2.8tonnes ha⁻¹) 100% Nano-Nitrogen fertilizer has given the highest performance. Plant height, number of effective tillers count per plant, plant dry weight, and yield were all lowest in the treatment that did not use any fertilizer. As a result, Nano-Nitrogen might be used as a substitute for urea in the cultivation of rice cultivar 'Bg 250' in Sammanthurai's Sandy Regosol soil, resulting in lower nitrogen pressure on the environment.

B. Effect of nano urea on yield and yield attributes

The data about various crop growth attributes studies *viz.*, cob length, Rows cob⁻¹, cob weight (g) No. of grain cob⁻¹, Harvest index (g), grain and straw yield (q ha⁻¹) at harvest were recorded as influenced by various treatments are presented in Table 1.

Cob length, Rows cob⁻¹, cob weight (g) No. of grain cob⁻¹, Harvest index (g), grain and straw yield (q ha⁻¹) significantly increased due to foliar spray of SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) and found statistically at par with SPAD threshold 41-45 with nano urea spray @ 6 ml/l (T₉) and SPAD threshold 36-40 with nano urea spray @ 6 ml/l (T₆). This might be due increased photosynthates because of higher concentration of nano urea increased chlorophyll in leaves more number of leaves plant⁻¹, leaf area plant⁻¹ (dm²) leaf width (cm). nitrogen is an essential primary nutrient required for proper growth and development of crops. Nitrogen play important role in constituent of amino acids, enzymes and Photosynthetic pigment (Chlorophyll) and energy storage compound (ATP-ADP) in plant A similar result recorded by Cheenu Kashyap (2022) [2] indicated that, number of cob weight (g), straw yield and grain yield (kg ha⁻¹) highest recorded leaf colour threshold 5 with nano urea spray @ 6 ml/l. The results revealed a significant difference between the different fertilization treatments, the Rubae *et al.* (2019) [9] conducted an experiment on the effect of nano-nitrogen and manufactured organic fertilizer as supplementary fertilizer in the yield and its component for three synthetics of maize. nano fertilizer treatment T2 achieved the highest yield and yield attributes characters.

C. Effect of nano urea on economics

Gross monetary returns

During investigation foliar spray of SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) recorded (62024 Rs. ha⁻¹) higher gross monetary returns, while minimum gross monetary returns Rs.24660 ha⁻¹ was recorded in treatment T₁ with no fertilizer (control), respectively. Same types of results were reported by of Muhammad S., (2012) [7]

Net monetary returns

During investigation foliar spray of SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) recorded (37,424 Rs. ha⁻¹) higher net monetary returns, while minimum net monetary returns Rs.19500 ha⁻¹ was recorded in treatment T₁ with no fertilizer (control), respectively Each increasing level of nano urea increased the economic yield significantly which ultimately resulted in increased gross and net monetary return ha⁻¹. More net monetary returns were obtained due to more yields and less cost of cultivation. The above results are in conformity with the results of Mathukia (2014) [6].

B: C Ratio

The data in Table 1 showed that the integrated use of nano urea and nutrient management had a significant impact on B: C ratio. Application SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) registered highest B: C ratio (2.56) which was followed by SPAD threshold 41-45 with nano urea spray @ 6 ml/l (T₉) (2.49), SPAD threshold 36-40 with nano urea spray @ 6 ml/l (T₆) (2.38). The lowest benefit-cost ratio (1.87) was recorded in T₁ with no fertilizer (control).

Table 1: Mean plant height (cm), stem girth (cm), No. of leaf plant⁻¹, cob length (cm), cob weight (g), grain cob⁻¹, grain yield (q ha⁻¹), straw yield (q ha⁻¹) GMR, NMR and B: C ration at harvest influenced by various treatments

Treatments	Plant height (cm)	Stem girth (cm)	No. of Leaf plant ⁻¹	Cob length (cm)	Cob weight (g)	Grain cob ⁻¹	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest Index (%)	GMR (Rs. ha ⁻¹)	NMR (Rs. ha ⁻¹)	B:C ratio
T1: Absolute control	120.63	6.06	10.00	12.80	90.55	306.33	24.10	40.91	37.07	42660	19900	1.87
T2: 2% Urea spray	124.43	5.76	10.00	12.83	100.00	365.66	28.31	44.28	39.00	45074	22308	1.97
T3: 100% RDF (125: 60: 30 kg N: P ₂ O ₅ : K ₂ O)	153.79	5.56	10.86	13.15	101.66	380.66	27.86	41.27	40.30	49409	21381	1.76
T4: SPAD threshold 36-40 with nano urea spray @ 2 ml/l	149.80	5.7	10.60	12.96	97.00	350.66	27.53	37.25	42.49	48074	24834	2.06
T5: SPAD threshold 36-40 with nano urea spray @ 4 ml/l	160.05	6.16	10.91	12.53	102.55	384.66	28.60	35.62	44.53	51074	27434	2.16
T6: SPAD threshold 36-40 with nano urea spray @ 6 ml/l	183.02	7.36	11.86	13.99	117.40	426.33	32.20	40.16	46.30	57629	33429	2.38
T7: SPAD threshold 41-45 with nano urea spray @ 2 ml/l	145.71	5.8	10.26	12.98	100.00	332.33	27.07	39.91	40.41	48104	24864	2.06
T8: SPAD threshold 41-45 with nano urea spray @ 4 ml/l	149.13	5.96	10.66	13.28	103.50	357.00	30.48	37.34	43.14	53054	29414	2.24
T9: SPAD threshold 41-45 with nano urea spray @ 6 ml/l	183.15	7.16	11.74	14.5	117.76	441.00	34.14	41.75	44.98	60449	36249	2.49
T10: SPAD threshold 46-50 with nano urea spray @ 2 ml/l	148.16	5.7	9.86	13.23	99.50	337.00	27.61	36.05	43.37	48599	25359	2.09
T11: SPAD threshold 46-50 with nano urea spray @ 4 ml/l	171.96	6.26	11.00	13.06	109.13	430.00	29.53	38.35	43.50	53174	29534	2.24
T12: SPAD threshold 46-50 with nano urea spray @ 6 ml/l	188.55	8.72	12.00	15.07	119.86	447.00	34.42	41.85	45.12	62024	37824	2.56
S. E. (+)	2.29	0.22	0.21	0.38	2.71	20.49	1.34	0.63	-	526.66	526.66	0.006
C.D. at 5%	6.71	0.65	0.63	1.12	7.95	60.11	3.93	1.86	-	1580	1580	0.017
General mean	156.31	6.25	10.81	13.31	105.33	387.13	29.32	39.56	-	51610.60	27711.10	2.16

Conclusion

According to a one year investigation the following conclusion are made

1. The foliar application of SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) was found beneficial and productive for improving growth, yield attributes, yield of maize.
2. The foliar application SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) produced quality grain as well as fodder yield and improved soil status.
3. Foliar application of SPAD threshold 46-50 with nano urea spray @ 6 ml/l (T₁₂) found effective increasing yield attributes as well as seed yield, GMR, NMR and B:C ratio of maize.

Foliar application SPAD threshold 46-50 with nano urea spray @ 6 ml/l was found highly productive, profitable, and remunerative as compared to other foliar application of nano urea.

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