Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 95-97
Received: 22-09-2017
Accepted: 23-10-2017

Shashishekhar A Jawale
Ph. D at VNMKV, Parbhani, Maharashtra, India

VD Patil
Dean of VNMKV, Parbhani, Maharashtra, India

Sunil A Jawale
Ph. D at MPKV, Rahuri, Satpute UV, Maharashtra, India

Usha Satpute
Ph. D at PDKV, Akola, Maharashtra, India

Correspondence
Shashishekhar A Jawale
Ph. D at VNMKV, Parbhani, Maharashtra, India

Effect of soil fertility levels on chlorophyll content of maize crop

Shashishekhar A Jawale, VD Patil, Sunil A Jawale and Usha Satpute

Abstract
The field experiment was conducted at VNMKV Parbhani for two years in maize crop with variety African tall which comes under semi-arid tropics with annual rainfall ranging from 700 to 900 mm in VNMKV Parbhani. Chlorophyll is the most important independent factor affecting spectral reflectance. In growing crop on an average for chlorophyll 'a' was from 0.12 to 0.29 and 0.13 to 0.34 and for chlorophyll 'b' concentration of maize leaves increase from 0.52 to 0.76 mg g^{-1} and 0.57 to 0.74 mg g^{-1}. However total Chlorophyll concentration in maize leaves about 0.64 to 1.04 and 0.67 to 1.09 mg g^{-1} in two successive year. At 60 days after sowing chlorophyll a, b and total chlorophyll concentration decreases may be due to stage of maturity. Further, only nitrogen fertilization contributed significantly to total chlorophyll production followed by the additional P + S + Zn + Fe fertilizer (Treatment F_5). With addition of each nutrient application (from treatment F_1 to F_5) there was increase in chlorophyll content in maize.

Keywords: Chlorophyll 'a', Chlorophyll 'b'

Introduction
When electromagnetic energy from the sun strikes plants, three things can happen. Depending upon the wave length of the energy and characteristics of individual plants, the energy will be reflected, absorbed, or transmitted. Reflected energy bounces off leaves and is readily identified by human eyes as the green color of plant. A plant looks green because the chlorophyll in the leaves absorb much of the energy in the visible wavelengths and the green color is reflected. Sunlight that is not reflected or absorbed is transmitted through the leaves to the ground. Interactions between reflected, absorbed, and transmitted energy can be detected by remote sensing. The differences in leaf color, texture, shape or even how the leaves are attached to plants, determine how much energy will be reflected, absorbed and transmitted. The relationship between reflected, absorbed and transmitted energy is used to determine spectral signatures of individual plants. Spectral signatures are unique to plant species.

Plant pigments are of tremendous significance in the biosphere. Indeed it is urged that the chlorophylls on plants are most important organic molecule as they are necessary for photosynthesis, the carotenoids are essential for plant and mammal survival through their photosynthetic and nutritional function, while other pigment groups are key to the physiology of plants and the organisms with which they interact (Davis 2004).

There is relationship between plant pigments with spectral reflectance. Spectral reflectance of leaves is influenced primarily by plant pigments, chlorophyll and carotenoids. Such reflectance can be used to study the changes in chlorophyll content. The changes in chlorophyll which is the primary pigment of leaves and stimulates photosynthesis are determined by spectral indices like NDVI (Normalized Difference Vegetation Index). The primary pigments, chlorophyll 'a', chlorophyll 'b', carotene and xanthophylls absorb incident light for photosynthesis. The chlorophyll content of leaf tissue is different for different species developed and growth stages of the plant that is Chlorophyll 'a' absorbs at wavelengths of 0.45 and 0.66 μm and chlorophyll 'b' absorbs at wavelength of 0.45 and 0.65 μm. The carotenoids absorb blue and green light at a number of wavelengths Patil and Malewar (1994) [6].

Among the various pigments that influence the spectral reflectants of vegetation chlorophyll. It contributes more than 70% to spectral reflectance and hence in the present investigation efforts were made to find out the effect of nutrient application on chlorophyll 'a', chlorophyll 'b' and total chlorophyll and to study the relationship between chlorophyll concentration and spectral reflectance for two consecutive years.

Material Methods

A field experiment on maize comprising of six fertility levels, replicated four times were laid out during late kharif. The observation on chlorophyll 'a', chlorophyll 'b' and total chlorophyll, was determined. Chlorophyll content was determined using a spectrophotometer (Spekol type) at the appropriate wavelength. For chlorophyll a, the measurement of absorbance of the extract was performed at the wavelength of 663 nm and for chlorophyll b at the wavelength of 645 nm. The content of chlorophyll a, chlorophyll b and total chlorophyll a + b was calculated using the formulas from the paper by Arnon (1949). The amount of particular pigments was given in μg g-1 of the fresh weight: chlorophyll a = (12.7· A663 – 2.7 · A645) · V · (1000 W)-1; chlorophyll b = (22.9 · A645 – 4.7 · A663) · V · (1000 W)-1; total a + b = (20.2· A645 – 8.02 · A663) · V · (1000 W)-1, where Aw is the absorbance at a given wavelength w, V – the total volume of the extract (cm3) and W – the weight of a sample (g).

Table 1

Different fertility levels used		
Treat No.	**Treat**	**Treatment Details**
1	F_0	No Fertilizer application
2	F_1	only N 150 kg N /ha
3	F_2	N + P (150 kg N /ha+ 50 kg P_2O_5/ha)
4	F_3	N + P + S (150 kg N/ha + 50 kg P_2O_5/ha+30 kg S/ha)
5	F_4	N + P + S (150 kg N/ha + 50 kg P_2O_5/ha + 30 kg S/ha + 20kg $ZnSO_4$/ha)
6	F_5	N + P + S (150 kg N/ha + 50 kg P_2O_5/ha + 30 kg S/ha + 20kg $ZnSO_4$/ha + 20 kg ZnSO4 / ha + 2% Fe foliar spray at two stages)

Results

The periodical observations of chlorophyll 'a' concentration recorded on various dates under varied fertility level treatment are presented in Table 2. On average chlorophyll 'a' concentration of maize was found to be increased with growth of maize crop up to 30 days after sowing 0.17 to 0.29 mg g^{-1} and at 60 days 0.17 to 0.3 mg g^{-1} as after sowing in two year respectively. Thereafter there was decrease in chlorophyll 'a' concentration at 90 days of sowing as 0.20 and 0.21. It was further noted that the application of nitrogen over no nitrogen (Treatment F_1) enhanced the chlorophyll content at all growth stages. The role of nitrogen in chlorophyll synthesis is of vital importance. Nitrogen enhances the chlorophyll concentration in plants. Similar to nitrogen (F_5) treatment i.e. spraying of 2% iron increased the chlorophyll concentration in the leaves. The pooled mean of two year showed lowest chlorophyll 'a' content 0.12 and 0.13 mg g^{-1} in control treatment. While, highest chlorophyll content 0.29 and 0.34 mg g^{-1} was observed in the treatment receiving complete nutrient package (F_5). Similer finding noted by Bodkhe, A.B. and Patil V.D. (2008) and Dixit, R.S. (1987) [2, 4]

Table 2: Effect of fertility level on Chlorophylla

Effect Of fertility level on chlorophyll 'a'								
	Ist Year				**IInd Year**			
	30 DAS	**60 DAS**	**90 DAS**	**Mean**	**30 DAS**	**60 DAS**	**90 DAS**	**Mean**
F_0	0.07	0.11	0.09	0.12	0.09	0.12	0.11	0.13
F_1	0.14	0.16	0.14	0.15	0.07	0.15	0.10	0.10
F_2	0.21	0.3	0.24	0.25	0.17	0.26	0.2	0.21
F_3	0.17	0.38	0.23	0.26	0.23	0.36	0.23	0.27
F_4	0.23	0.39	0.28	0.29	0.22	0.42	0.29	0.31
F_5	0.19	0.42	0.32	0.29	0.22	0.49	0.33	0.34
Mean	0.17	0.29	0.20		0.17	0.3	0.21	
	SE ±		0.021		SE ±		0.023	
	CD 5%		0.061		CD 5%		0.069	

On an average chlorophyll 'b' concentration of maize was found to be increased with growth of maize crop up to 60 days after sowing in, respectively (Table 3). Thereafter there was decrease in chlorophyll 'b' concentration till 90 DAS in the respective years. The chlorophyll increase was from 0.34 to 0.96 and 0.34 to 0.94 in first two observations. The pooled mean of two year showed lowest chlorophyll 'b' content 0.52 and 0.57 mg g^{-1} in control treatment. While, highest chlorophyll content 0.76 and 0.74 mg g^{-1} was observed in the treatment receiving complete nutrient package (F_5).

At various growth stages and under various fertility levels chlorophyll 'b' showed a similar pattern as that of chlorophyll 'a'. However, on chlorophyll 'b' concentration was relatively more than chlorophyll 'a'. Blackburn, G.A. (1998) and Costa, C. (1991) observe the same finding.

Table 3: Effect of fertility level on Chlorophyll b

	Ist Year				**IInd Year**			
	30 DAS	**60 DAS**	**90 DAS**	**Mean**	**30 DAS**	**60 DAS**	**90 DAS**	**Mean**
F_0	0.22	0.81	0.69	0.52	0.32	0.81	0.73	0.57
F_1	0.28	0.92	0.81	0.60	0.38	0.93	0.77	0.66
F_2	0.35	0.95	0.84	0.65	0.32	0.94	0.81	0.63
F_3	0.35	1	0.87	0.68	0.34	1.04	0.86	0.69
F_4	0.37	1.01	0.87	0.69	0.42	1.07	0.89	0.75
F_5	0.45	1.06	0.91	0.76	0.23	0.84	0.7	0.74
Mean	0.34	0.96	0.83		0.34	0.94	0.79	
	SE ±			0.026	SE ±			0.035
	CD 5%			0.079	CD 5%			0.107

The data on total chlorophyll content in maize leaves are presented in Table No. 4 are depicted in Figure 1 and 2.
On average total chlorophyll concentration of maize was found to be increased with growth of maize crop up to 30 days after sowing 0.51 and 0.51 mg g^{-1} to 60 days 1.25 and 1.24 mg g^{-1} as after sowing in two year respectively. Thereafter there was decrease in total chlorophyll concentration at 90 days of sowing as 1.04 and 1.01. The pooled mean of two year showed lowest total chlorophyll content 0.64 and 0.67 mg g^{-1} in control treatment. While, highest chlorophyll content 1.04 and 1.09 mg g^{-1} was observed in the treatment receiving complete nutrient package (F_5). Further, only nitrogen fertilization contributed significantly to total chlorophyll production followed by the additional P + S + Zn + Fe fertilization (Treatment 5). With each additional nutrient application (from treatment F_1 to F_5) that was increase in chlorophyll content in maize.

Chlorophyll concentration of the leaves influences the leaf biochemical properties and biochemical interactions are the result of molecular / atomic composition of the leaf. In turn they are responsible for colour changes resulting from differences in pigment concentration. In this whole chain nitrogen, sulphur, and iron play an important role. In the present study chlorophyll 'a', chlorophyll 'b' and total chlorophyll was found to be influenced by the application of essential plant nutrients particularly nitrogen, sulphur, and iron. With the advancement of growth up to silk formation (30 to 60 DAS) of maize the chlorophyll concentration in the leaves was increased. Likewise, differences were found between the periods. The higher reflectance was found at 90 days after planting, which may have been related to the incidence of some brown pigments that increase when a plant is in senescence. Patil and Malewar (1994) [6] reported similar findings in cotton crop. Similarly, Gausman *et.al.* (1973) [7] showed the role of nitrogen in chlorophyll synthesis.

Table 4: Effect of fertility level on total Chlorophyll

Total chlorophyll concentration as influenced by fertility levels								
	Ist Year				**IInd Year**			
	30 DAS	**60 DAS**	**90 DAS**	**Mean**	**30 DAS**	**60 DAS**	**90 DAS**	**Mean**
F_0	0.34	0.92	0.82	0.64	0.35	0.96	0.86	0.67
F_1	0.42	1.08	0.95	0.75	0.39	0.96	0.81	0.67
F_2	0.56	1.25	1.08	0.90	0.55	1.19	0.97	0.87
F_3	0.52	1.38	1.10	0.94	0.55	1.30	1.04	0.90
F_4	0.60	1.40	1.12	0.98	0.56	1.46	1.15	1.00
F_5	0.64	1.48	1.16	1.04	0.64	1.56	1.21	1.09
	0.51	1.25	1.04		0.51	1.24	1.01	
	SE ±		0.069		SE ±		0.074	
	CD 5%		0.207		CD 5%		0.227	

Conclusion
The various growth parameters of maize viz., chlorophyll 'a', chlorophyll 'b' and total chlorophyll were improved significantly due to application of 150 kg N, 50 kg P_2O_5, 50 kg k_2O,30 kg S, 20 kg $ZnSO_4$ per hectare and two foliar spraying of 2% iron.
The predominance of chlorophyll a in the plant tissue compared with the other pigments and the strong positive relationship between chlorophyll 'b' resulting in concurrent increases of both pigments suggests that the chlorophylls had a greater influence on spectral reflectance.

References

1. Blackburn GA. Quantifying chlorophyll and carotenoids at leaf and canopy scale and evaluation of some hyper spectral approaches. Remote Sensing Environment. 1998; 66(3):273-285.
2. Bodkhe AB, Patil VD. Concentration of chlorophyll and other plant pigments in Acalypha and Golden duranta. M.Sc. (Agri.) thesis, Department of soil science and Agricultural Chemistry M.A.U., Parbhani, 2008.
3. Costa C. Nitrogen rates and chlorophyll content in maize leaves Photosyntheticaly. 1991; 25(3):447-445.
4. Dixit RS. Relationship between chlorophyll and other pigment with their nutrient application. IARI, New Delhi, 1987, 110-114.
5. Hitchcook J. Leaf chlorophyll analysis. Remote sensing for agriculture and the environment Greece Ella, 1979, 83-88.
6. Patil VD, Malewar GU. Yield and chlorophyll content of cotton as influenced by micronutrient sprays. J. Cotton Res. And Dev. 1994; 8(2):189:192.
7. Gausaman HW, Allen WA, Weigand CL, Escobra DF, Rodriguez RR, Richardson AJ. The leaf mesophyll of twenty crops, their life spectra and optical and geometrical parameters. USDA Tech. Bull. 1973; 1465:59.