DETERMINATION OF THE EFFECTS OF DIFFERENT FERTILIZER APPLICATIONS ON SWEET CORN

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Abstract

Two varieties of sweet corn were compared; Gold Rush and Chocolate in this study. Three fertilization regimes were used: 1. Organic (1200 kg/ha); 2. Organic (600 kg/ha) and half urea (86.5 kg/ha); 3. Di amino phosphate (DAP) (50 kg/ha) and urea (173 kg/ha). Same irrigation amount was applied for all plots by using furrow irrigation method. NDVI was estimated by using RS technique to determine vegetation index. By using same technique canopy temperatures were estimated. Chocolate variety was highest in NDVI value (0.58) when Organic+Half Urea was applied. Plant height and leaf area were measured from each plot. Gold Rush variety produced the tallest plant with 119.4 cm at the Organic+Half Urea fertilizer application. The biggest leaf area (46.08 cm^2) was measured from Gold Rush variety with DAP+Urea fertilizer application. Sugar content also determined by using Rea fracto meter. The highest sugar content was 14% for the Gold Rush variety by applying Organic+Half Urea and DAP+Urea. When all findings were evaluated, Organic+Half Urea fertilizer application was found to give better results.

Key words: fertilizer, RS, NDVI, corn.

INTRODUCTION

Remote sensing (RS) is the science of getting information about objects or areas remotely without contact (Anonymous, 2017), and it has been used very much in recent years for agricultural purposes (Tanriverdi, 2010; Tanrıverdi et al., 2017). One of the models in RS that have been used in this study is The Normalized Difference Vegetation Index (NDVI). NDVI is one of the most commonly utilized vegetation indexes and its' utility in satellite estimation and monitoring of global vegetation cover has been well indicated over the quarter of a century (Huete, Liu, 1994; Leprieur et al., 2000). NDVI is associated with some biophysical properties of canopy crops such as leaf area index (LAI), fractional vegetation cover, vegetation cover and biomass. Furthermore, the virtually essential pigment in converting of light energy to stored chemical has a direct effect on NDVI. RS of chlorophyll content in crop canopies can help ensure a low-cost alternative to crop or soil example (Scharf et al., 2002; Hatfield et al., 2008). Moreover, chlorophyll content is nearly related to N supply and also utilized to diagnose corn N status and predict corn grain output potential (Bullock,

Anderson, 1998; Pandey et al., 2000; Vetsch, Randall, 2004). NDVI rises near-linearly with rising LAI and enters an asymptotic phase in which NDVI rises leisurely with rising LAI. Thermal infrared radiation IR plays a crucial role in determining the earth's climate and its sensitivity. It is, therefore, important to have an accurate IR radiation parameterization in atmospheric general circulation models (GCMs) used for studying climate change.

Sweet corn (*Zea mays* L. *saccharata*) is a variety of high sugar content of corn. Sweet corn is the result of natural mutation recessive genes that control the conversion of sugar to starch inside the endosperm of the nucleus of an atom. Corn is the second most important crop in the world after wheat and before rice. Also there is an increasing tendency for commercial production of sweet corn (Arun Kumar et al., 2007). In order to increase the productivity of the crop and enhancing the quality different types of fertilizer should be applied to the soil and in form of synthetic or organic fertilizers.

In Iraq, many farmers are still following traditional methods to agricultural works. That was the reason new technological tools (RS, SPAD 502 meter Minolta Japan, Thermal Infrared, GreenSeeker HandHeld Greenseeker,

USA) were used in this study because of increase yield and quality of agricultural crop. With this way this study can be quid for farmers in Iraq.

Kanipanka and Zrigwez are agricultural regions in sweet corn breeding, two different locations famous for their soil and environmental suitability. This study was carried out to increase agricultural income in these two regions and to use different organic and chemical fertilizers to determine the effect of fertilizer varieties on plant production. In recent years, the demand for this crop has increased. For this reason, the main aim of this study is to investigate the correct fertilizer preferences by making experiments with various fertilizer applications with the help of collected data using RS to increase corn production.

MATERIALS AND METHODS

Field Expermental Site. The field experiment was carried out on 31 August 2016 in two research stations with different soil types (Table 1) of Sulaimaniya directorate of agriculture research; Kanipanka~40 km away from Sulaimanya, at 582 m above sea level with (35°22'25''N, 45°43'25''E) and Zirgwez Agricultural Station~30 km away from Sulaimanya, and located at 830 m above sea level with (35°22'50''N, 45°27'50''E). The two cultivars used in this project, Gold rush and chocolate were provided by the Sulaimaniya Directorate of Agriculture Research. To make the decision of fertilizer amount soil samples collected from the study area (Table 1).

Table 1. Soil chemical and physical value of both locations

Soil chemical and physical	Location	
	Kanipanka	Zirgwez
Soil texture	Salty clay	Salty clay
Ec Ds 25°	0.16	0.18
PH	0.85	7.76
N%	0.13	0.1
Available P(ppm)	7.44	7.75
Soluble K^+ Meq/L	0.051	0.051
Soluble Na^+ Meq/L	0.186	0.108
Soluble Ca^+ Mq/L	1.6	1.3
Soluble Mq^+/L	2.1	3.7
CL Meq/L	0.9	0.9
OM%	1.53	1.39
$CaCo_3$%	19.5	21.5
HCO_3 Meq/L	0.9	1.1
CO	0.6	0.9

To understand the climatically differences at the two location of the study area, air temperature were measured (Table 2).

Table 2. Average temperature of study both locations

Months	Location			
	Kanipanka		Zirgwez	
	maximum	minimum	maximum	minimum
August	45	21	43	26
September	39	16	37	17
October	30	8	31	14
November	25	2	21	6
December	11	-2	12	1

Experimental treatments and design. The experimental design was a split plot design with 3 fertilizers (Table 3) randomised on the main-plots and 2 genotypes randomised on sub-plots in three replicates. Each plot was 3 furrows with 2 m length and 0.75 m. The genotypes within the experiment were sown at the same plant population 66,000 plants/ha.

Table 3. Type and amount of fertilizers

Fertilizer type	Applied quantity
Organic	(1200 kg/ha)
Organic+ Urea	(600 kg/ha)+(86.5 kg/ha)
Di amino phosphate + Urea	(50 kg/ha)+ (173 kg/ha)

Field irrigation. After the end of planting all the seeds starts the irrigation process and the first day is the first day of the plant life.

Field Measurements

NDVI. NDVI was measured on three occasions; before Nitrogen application, pre and pose a study for each plot in three replicates using GreenSeeker Hand Held Green seeker, USA. This instrument measures the amount of NIR and red NIR reflected by the canopy.

Leaf chlorophyll content. These transmittance values are used by the device to derive a relative SPAD meter value that is proportional to the amount of chlorophyll in the sample. In this experiment, three measurements were taken from each leaf at the base, middle and top of the flag leaf for three plants in each plot.

Chlorophyll content measurement. These transmittance values are used by the device to derive a relative SPAD meter value that is proportional to the amount of chlorophyll in the

sample. In this experiment, three measurements were taken from each leaf at the base, middle and top of the flag leaf for three plants in each plot.

Canopy temperature. This parameter was measured in two occasions; before second amount of N application and at tasselling using infrared thermometer AR320 Infrared Thermometer China manufacturer with infrared temperature.

Leaf area. The length of the leaves of three randomized plants was measured in each plot at slicking stage (Leaf area= length * 0.64).

RESULTS AND DISCUSSIONS

NDVI. Two measurements were recorded in before second N amount application, pre and pose tasseling for all plots (Table 4). The statistical analysis showed that the interaction of variety and fertilizers had significant differences in Zirgwez location before the second amount of N was applied. Chocolate variety was higher in NDVI value when (Organic+Half Urea) fertilizer was applied NDVI 0.58. However, the analysis of NDVI at Kanipanka location was non-significant for both cultivars at all three fertilizer types condition.

Table 4. Mean data for NDVI before second N amount application, pre and pose tasseling stage at both locations

Location	Kanipanka						Zirgwez					
Variety	Gold rush			Chocolate			Gold rush			Chocolate		
Fertilizer	Organic	Organic+Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea
before N	0.39	0.46	0.42	0.48	0.38	0.39	0.33	0.44	0.37	0.35	0.38	0.45
at tasseling	0.46	0.54	0.53	0.53	0.51	0.54	0.46	0.46	0.36	0.54	0.58	0.56
after tasseling	0.43	0.46	0.45	0.42	0.44	0.49	0.41	0.36	0.4	0.42	0.40	0.39

Leaf chlorophyll content. Three measurements were taken from each leaf at the base, middle and top of the flag leaf for three plants in each plot (Table 5).

The cultivars were differed in leaf chlorophyll content at tasselling stage in Zirgwez location. The fertilizers had various effects on the two cultivars, the leaf chlorophyll content of Gold rush variety was higher than the Choocalate variety (43.72) (SPAD value 1 and 2) respecttively. At Kanipanka location, the fertilizers had affected the leaf chlorophyll content. However, this effect was the same for both cultivars.

Table 5. Mean data for leaf chlorophyll content before second N amount application, pre and pose tasseling stage at both locations

Location	Kanipanka						Zirgwez					
Variety	Chocolate			Gold rush			Chocolate			Gold rush		
Fertilizer	Organic	Organic + Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea	Organic	Organic+Half Urea	DAP+Urea
before N	30.23	23.77	38.04	40.12	30.13	36.51	35.2	34.91	37.53	33.48	36.92	32.1
at tasseling	23.77	28.37	41.13	33.36	35.79	41.54	26.06	34	37.33	32.63	34.71	43.72
after tasseling	28.23	33.88	43.63	35.02	36.78	46.03	29.74	34.44	37.79	33.97	41.53	43.37

Plant height. Plant height was measured from ground level to the tip of the tassel of the plant using a ruler on 3 randomly selected plants in each plot for all replicates (Table 6).

The cultivars showed variation in plant height Gold rush variety produced the tallest plant with 119 cm at Zirgwez location.

Canopy temperature. This parameter was measured in two occasions; when plant height reached 25 cm and at tasselling using infrared thermometer (Table 7). The value of canopy temperature was the highest at Kanipanka location for gold rush variety 19.09 when the parameter was measured at 25 cm plant height when DAP and Urea was applied.

When the parameter was measured at tasseling stage, the value of canopy temperature was the highest at Zirgwez location for the Chocolate variety in organic treated plots 20.43. However, when the treatments were compared statistically no significant variations were found.

Sugar content: This data was measured after harvesting from 3 cobs for each treatment Rea fracto meter device. The highest sugar content was 14% for the Gold rush variety that was treated with DAP + Urea and Organic + Half Urea (Table 8). However, no significant differences were found when the treatments were statically compared.

Table 6. Mean data for plant height at tasseling stage at both locations

Location	Kanipanka						Zirgwez					
Variety	Gold rush			Chocolate			Gold rush			Chocolate		
Fertilizer	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea
Plant height cm	99.3	122.8	110.8	92.8	92.8	94.8	104.47	119.40	114.87	81.97	86.17	85.61

Table 7. Mean data for canopy temperature when plant height reached 25 cm and at tasselling

Location	Kanipanka						Zirgwez					
Variety	Chocolate			Gold rush			Chocolate			Gold rush		
Fertilizer	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+Half Urea	DAP+ Urea	Organic	Organic+Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea
before tasseling	18.57	18.79	19.09	17.21	17.19	16.77	13.42	13.69	13.58	13.62	13.69	13.58
at tasseling	17.21	17.19	16.77	17.32	16.96	16.89	20.11	20.16	20.28	20.43	19.93	19.07

Table 8. Mean data for % sugar content of the corn

Location	Kanipanka						Zirgwez					
Variety	Gold rush			Chocolate			Gold rush			Chocolate		
Fertilizer	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea	Organic	Organic+ Half Urea	DAP+ Urea
N Leaf	8	9	8	7	7	7	8	8	7	6	7	7

CONCLUSIONS

The challenge in agriculture is to optimize the trade-off between quality and the environmental impacts associated with high fertilizer application in extensive production system. This study was set out to identify variation between a set of sweet corn for physiological traits associated with fertilizer use efficiency using RS technologies.
The results showed that NDVI as RS toll might be suitable to use as a method to determine N efficiency in sweet corn with respect of the environmental conditions.
Optical sensing showed cultivars variation in leaf chlorophyll content especially at tasseling stage indicates the potential of this parameter in assessing plant nutrient levels.
NDVI measuring technologies gives high opportunity in estimating plant nutrient levels.
There is an opportunity for the utilization of these parameters NDVI, chlorophyll content and canopy temperature in other projects.

It's useful to apply RS technologies in plant nutrient content projects especially for large areas.RS has chance in spatial analysis of crop nutrient requirements and fertilizer management.
By using GreenSeeker HandHeld for determine the NDVI is an easy, cheap and precise way.

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