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INSECTICIDAL EFFECTS ON FRUITING AND YIELD ENHANCEMENT IN COTTON

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Abstract

Past research in cotton (*Gossypium hirsutum L.*) has indicated that some pesticides, including insecticides, may contain plant growth regulator (PGR) properties (Lincoln and Dean, 1976; Cothren et al., 1984; Bauer and Cothren, 1990). TRIMAX™, an imidacloprid, an insecticide produced by the Bayer Corporation and Centric® 40WG, a thiamethoxam, an insecticide produced by Syngenta, may both have similar insecticide and PGR qualities associated with them.

A field study was conducted at the Texas A&M Agricultural Experiment Station in Burleson County, Texas. The study was conducted under irrigated conditions to observe the physiological effects of foliar treatments of TRIMAX™ and Centric® 40WG on early season plant growth, chlorophyll content, yield, and fiber quality. A secondary objective of the study was to determine the correlations between data derived from a Minolta SPAD meter, total nitrogen content, and chlorophyll content of cotton. The experimental design consisted of four replications within a randomized complete block (RCB). Treatments consisted of one, two, and three applications of TRIMAX™, one, two, and three applications of Centric® 40WG, and a control, totaling seven treatments within the RCB. TRIMAX™ was applied at a labeled rate of 1.5 oz/A for each treatment. Timings of these applications occurred at the 10-leaf stage, 10-leaf stage plus 10 days after initial treatment (DAIT), and 10-leaf stage plus 10 DAIT plus 20 DAIT. Like applications of Centric® 40WG, applied at a labeled rate of 1.33 oz/A, were made at the same timings as for TRIMAX™. Data was observed and recorded for plant height, total nodes, SPAD readings (as a reference for chlorophyll content), chlorophyll analysis, nitrogen analysis, biomass partitioning, mid-season plant mapping, end of season box mapping, and yield and fiber quality analysis.

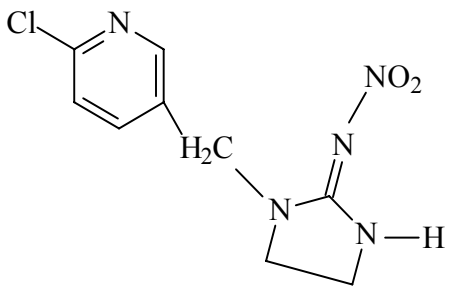
The three treatment of TRIMAX™ and the three treatment of Centric® 40WG all showed numerical increases in lint yield over the untreated control, however no significant differences were observed. Three applications of TRIMAX™ showed the greatest numerical increase in lint yield followed by one and two applications of TRIMAX™ then one, three, and two applications of Centric® 40WG. Percent nitrogen and SPAD values were highly correlated at $P < .001$. A simple linear regression model was chosen for the correlation between SPAD values and nitrogen content: $\%\ N = 12.564 - (0.182 \times SPAD)$. However, no correlation was found for chlorophyll levels in relation to nitrogen content or SPAD values. SPAD reading did increase from one application to the next but no significant differences were found. Also height, node, and biomass partitioning data showed no significant differences at any time during the growing season. To evaluate the physiological responses to foliar treatments of TRIMAX™ and Centric® 40WG additional studies will be necessary.

Introduction

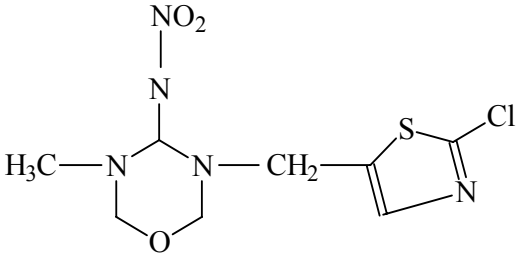
Past research in cotton (*Gossypium hirsutum L.*) has indicated that some pesticides, including insecticides may contain plant growth regulator (PGR) properties (Lincoln, 1976; Cothren et al., 1984; Bauer and Cothren, 1990). These PGR properties are thought to increase yields with multiple foliar applications when applied to cotton.

TRIMAX™, imidacloprid, an insecticide produced by the Bayer Corporation has been reported to have PGR properties, and Centric® 40WG, thiamethoxam, a similar insecticide produced by Syngenta, may also have PGR qualities.

TRIMAX™
Imidacloprid Structure
$C_9H_{10}ClN_5O_2$



Centric® 40WG
Thiamethoxam Structure
$C_8H_{10}ClN_5O_3S$



A field study was conducted at the Texas A&M Agricultural Experiment Station in Burleson County, Texas under irrigated conditions to observe the physiological effects of foliar treatments of TRIMAX™ and Centric® 40WG on early season plant growth, chlorophyll content, nitrogen content, yield, and fiber quality of cotton.

Objectives

To evaluate cotton response to repeated foliar applications of TRIMAX™ and Centric® 40WG for early season plant growth, chlorophyll content, nitrogen content, yield, and fiber quality.

To determine the correlations between data derived from a Minolta SPAD meter, total nitrogen content, and chlorophyll content of cotton.

Hypothesis

Repeated applications of TRIMAX™ and Centric® 40WG should increase crop response, overall physiological activity, and crop growth rates to potentially increase yield.

A correlation should exist between data derived from a Minolta SPAD meter, total nitrogen content, and chlorophyll content data.

Materials and Methods

Field Information

Variety Planted:	DPL 451 B/RR
Fertilizer:	120 lbs N / A (32-0-0)
Date Planted:	May 18, 2003
Experimental Design:	Randomized Complete Block with four replications
Study Size:	7, 4 row treatments x 4 ranges
Plot and Alley Size:	40" row spacing, 32 foot plots, 13 foot alleys

Application Information

Treatment:	Timing:	Rate:
Control	N/A	N/A
Centric	10-leaf	1.33 fl oz/A
Centric	10-leaf + 10DAIT	1.33 fl oz/A
Centric	10-leaf + 10DAIT + 20DAIT	1.33 fl oz/A
Trimax	10-leaf	1.5 fl oz/A
Trimax	10-leaf + 10DAIT	1.5 fl oz/A
Trimax	10-leaf + 10DAIT + 20DAIT	1.5 fl oz/A

The experimental design was a randomized complete block (RCB) consisting of seven treatments and four replications. Treatments consisted of both insecticides, TRIMAX™ and Centric® 40WG, being applied singly for one, two, and three applications, and an untreated control. TRIMAX™ was applied at a labeled rate of 1.5 oz/A for each treatment. Timings of these applications occurred at the 10-leaf stage, 10-leaf stage plus 10 days after initial treatment (DAIT), and 10-leaf stage

plus 10 DAIT plus 20 DAIT. Centric® 40WG was applied at a labeled rate of 1.33 oz/A at the same timings as for TRIMAX™. Data was collected for plant height, total nodes, SPAD readings (as a reference for chlorophyll content), chlorophyll analysis, nitrogen analysis, leaf area index (LAI), biomass partitioning, mid-season plant mapping, end of season box mapping, and yield and fiber quality analysis.

Plant heights, total nodes, SPAD readings, chlorophyll analysis, nitrogen analysis, and LAI data were collected for each treatment at four timings throughout the season. The first data collection (T0) occurred at the 10-leaf stage prior to any applications of the insecticides. The second collection (T1) occurred 10 DAIT and prior to the second application. The third collection (T2) occurred 20 DAIT immediately prior to the third application, and the fourth collection (T3) occurred 30 DAIT.

SPAD readings were recorded using the Minolta SPAD 502 hand held chlorophyll meter. Chlorophyll content was collected using Hiscox and Israelstam's methods (Hiscox and Israelstam, 1979) and interpreted by Arnon's methods (Arnon, 1949). Analysis of leaf tissue for nitrogen content was conducted by The Plant and Soil Testing Laboratory at the Texas A&M University in College Station. Each of these data sets were collected from the same nodal position over the season.

Biomass partitioning, mid-season plant mapping, end of season box mapping, and yield were also analyzed. Fiber quality analysis was conducted by the International Textile Center in Lubbock, TX. Due to space limitations, biomass partitioning, mid-season plant mapping, end of season box mapping, and fiber quality data are not reported.

Statistical Analysis

Treatment means were subjected to analysis of variance using PROC GLM in SAS v8.0, and means were separated using Fisher's Least Significant Difference with = 0.05. Data from SPAD values, nitrogen content, and chlorophyll levels were subjected to regression analysis. A simple linear regression model was chosen for the correlation between SPAD values and nitrogen content: % N = 12.564 – (0.182 x SPAD).

Results

No statistical differences were observed between treatments for lint yield. However, all treatments exhibited numerically higher values for overall lint yield when compared to the untreated control (Fig. 1). Also, treatments of TRIMAX™ had numerically higher lint yields than treatments of Centric® 40WG. Treatments receiving three applications of TRIMAX™ produced the most lint yield.

Numerically higher values for all treatments were observed compared to the untreated control for plant height and total nitrogen content. All treatments from the initial data collection (T0) to 30 DAIT (T3) exhibited larger increases in plant heights relative to the untreated control (Fig. 2). Likewise the total nitrogen content in all treatments was higher than that for the untreated control at 30 DAIT (Fig. 3).

Chlorophyll levels for all treatments, excluding those receiving three applications of TRIMAX™, showed numerically higher values at 30 DAIT (T3) than the untreated control. Treatments receiving three applications of TRIMAX™ had slightly lower levels of chlorophyll than the control (Fig. 4).

SPAD readings from T2 to T3 reflected larger numerical increases than the untreated control with the treatments receiving three applications of TRIMAX™ or three applications of Centric® 40WG possessing the largest increases (Fig. 5).

No statistical differences were observed for total nodes or LAI between treatments throughout the season.

Percent nitrogen and SPAD values were highly correlated at $P < .001$ (Fig. 6). A simple linear regression model was chosen for the correlation between SPAD values and nitrogen content: % N = 12.564 – (0.182 x SPAD). However, no correlation was found for chlorophyll levels in relation to nitrogen content or SPAD values.

Conclusions

No statistical differences were found for early season plant growth, chlorophyll content, nitrogen content, yield, or fiber quality. However, repeated applications of TRIMAX™ and Centric® 40WG numerically increased crop response, overall physiological activity, and crop growth rates when compared to the untreated control.

As anticipated, a strong statistical correlation existed between % nitrogen and SPAD values. However, no correlation was found for chlorophyll levels in relation to nitrogen content or SPAD values.

Future Research

Data reported is based on the initial year of the study, and additional research is needed for verification of results. Future research is needed to determine if increased applications of TRIMAX and Centric® 40WG effectively increase PGR activity, while possibly further enhancing yield, along with addressing the economics of production cost between treatments.

Literature Cited

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Bauer, P.J. and Cothren, J.T. 1990. Growth-promoting activity of chlordimeform. Agron. J. 82:73-75.

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Hiscox, J.D. and Israelstam. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot. 57: 1332-1334.

Lincoln, C. and G. Dean. 1976. Yield and blooming of cotton as affected by insecticides. Ark. Farm Res. 25 (6) :5.

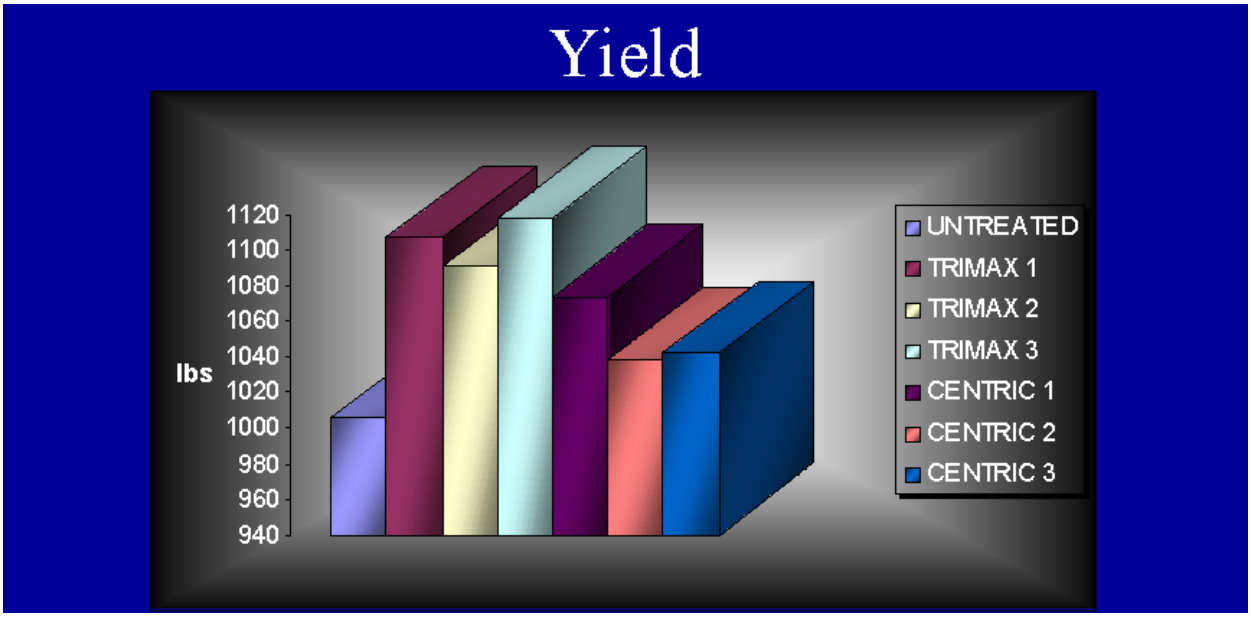

Fig. 1. Lint Yield in pounds for all treatments.

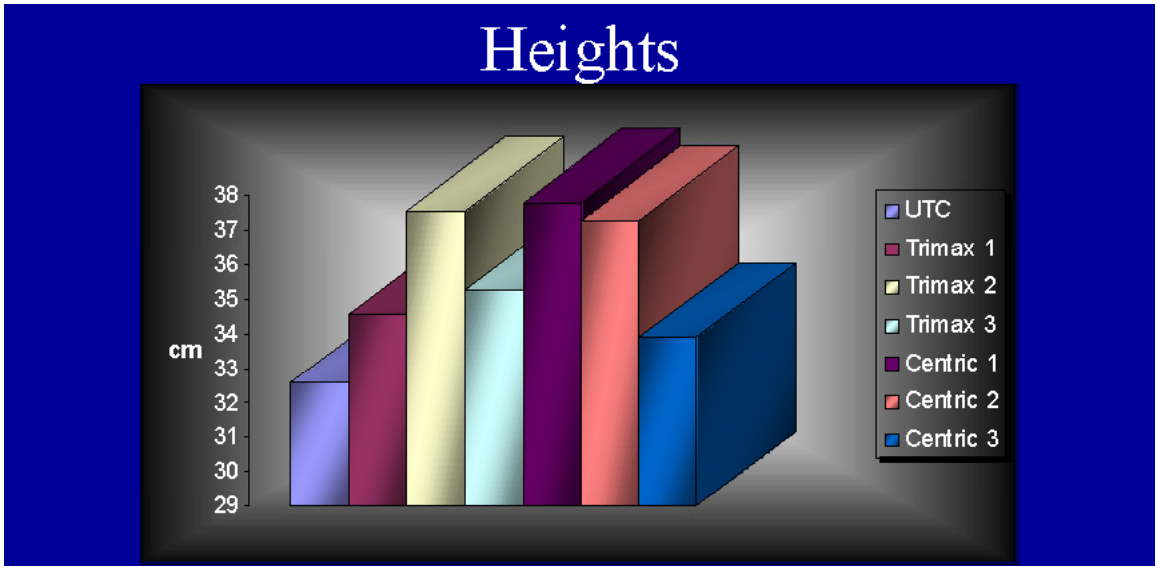

Fig. 2. All treatments exhibited greater increases in height over the control from T0-T3.

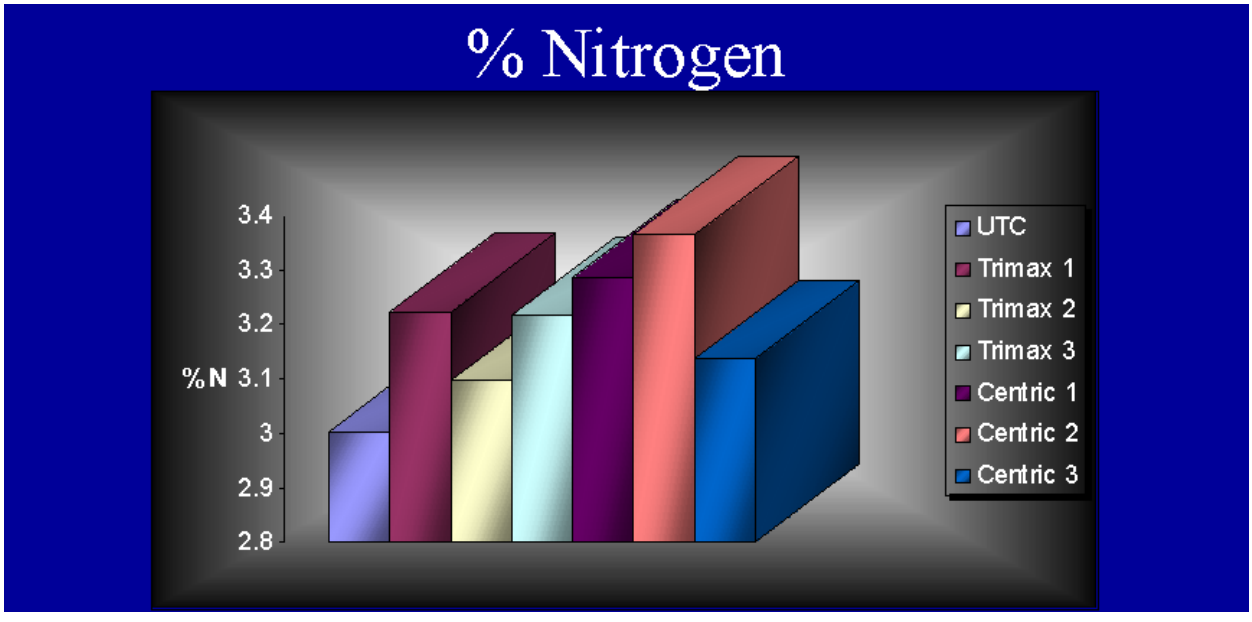

Fig. 3. All treatments exhibited higher levels of nitrogen content over the control at T3.

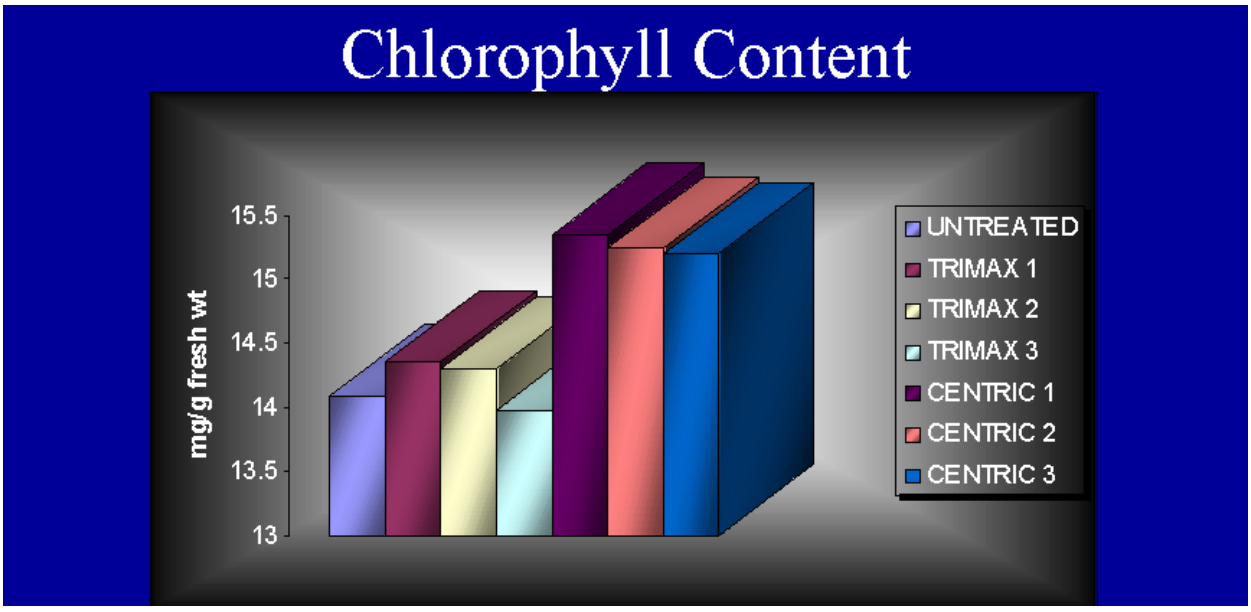

Fig. 4. All treatments exhibited higher increases in chlorophyll over the control from T0-T3.

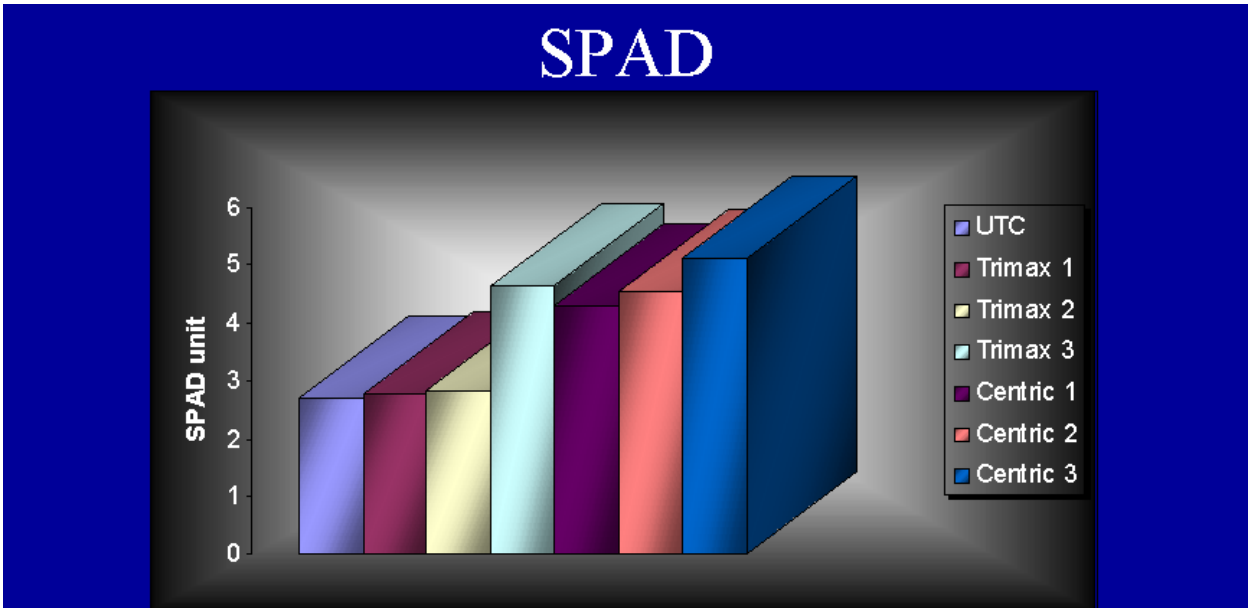

Fig. 5. All treatments exhibited greater increases in height over the control from T2-T3.

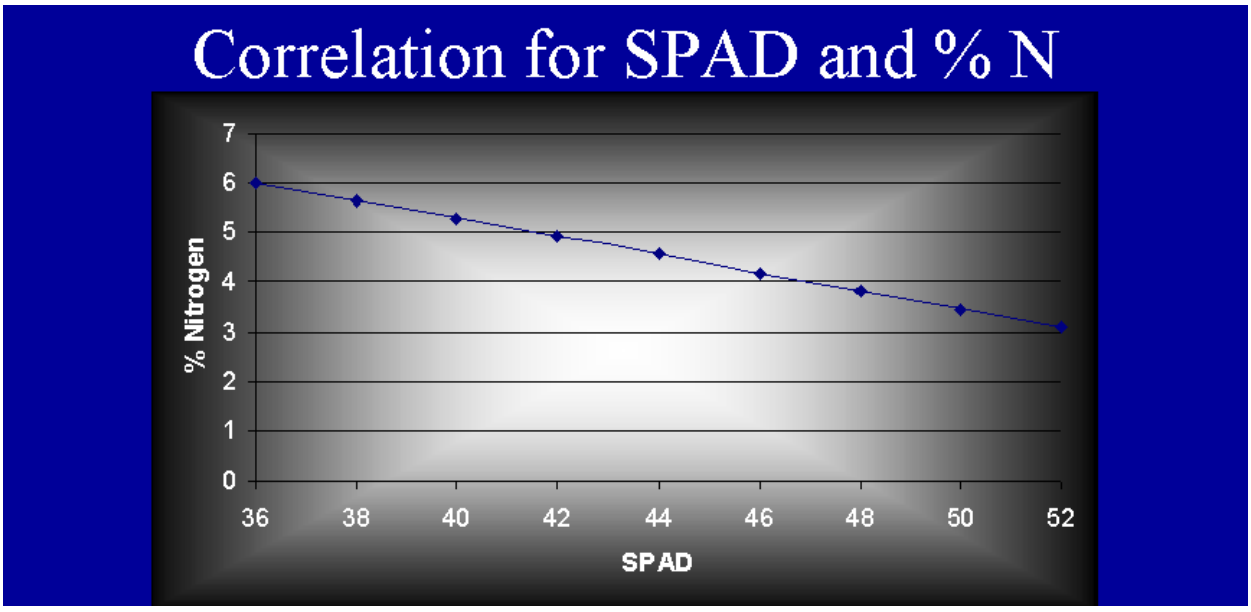

Fig. 6. &N = 12.564 – (.182 * SPAD)