Annual Report

Site: Scandia, Kansas (US)

Lat.: 39°49'52.62"N

Long.: 97°50'21.01"W

Treatment description

A total of five treatment were arranged in a randomized completely block design with five replications. Treatment description is shown in table 1.

Table 1. Treatment description for soybean study during the 2015 growing season, Scandia KS.

	(-)		Intensification		(+)
Treatments	**CP**	**CF**	**PI**	**EI**	**AD**
Seeding rate	110k	110k	174k	174k	174k
Row spacing (m)	30”	30”	15”	15”	15”
Inoculation	No	Yes	Yes	Yes	Yes
Fertilization	No P-K	P-K	No P-K	P-K	P-K
Micronutrients (Zn-B-Fe)	No	No	No	1x	2x
Fungicide	No	No	No	1x	2x
Insecticide	No	No	No	1x	2x

CP=Common practices, CF= comprehensive fertilization, PI= production intensification, EI= ecological intensification (CF+PI), AD= advanced plus.

Phenological information and soil characteristics

Complete information related to planting date and phenology is presented in Table 2. Soil characterization before planting can be reviewed in Table 3.

Table 2. Phenological data for the 2015 growing season for soybean.

Scandia Phenological Data	**Soybean**
Soybean Variety	P39T67R (MG 4.0)
Planting Date	05/28/15
Emergence Date (VE)	06/04/15
Flowering (R1)	07/29/15
Maturity	09/28/15
Harvest Time	10/14/15

Table 3. Soil characterization before planting time.

Scandia Soybean Studies	OM%	pH	P (ppm)
Irrigated	2.77	6.2	13.7
Dryland	2.83	6.1	13.1

Irrigation Schedule

The total amount of water provided to the irrigated condition was 7.5 inches (7/7, 7/15, 7/23, 8/5, 8/20, and 9/10). The total amount of rain registered during the growing season was 15.0 inches.

Weather conditions

Weather conditions for 2015 and historical (1980-2015) is show in Fig. 1.Temperature and precipitation ranged in normal values for this site.

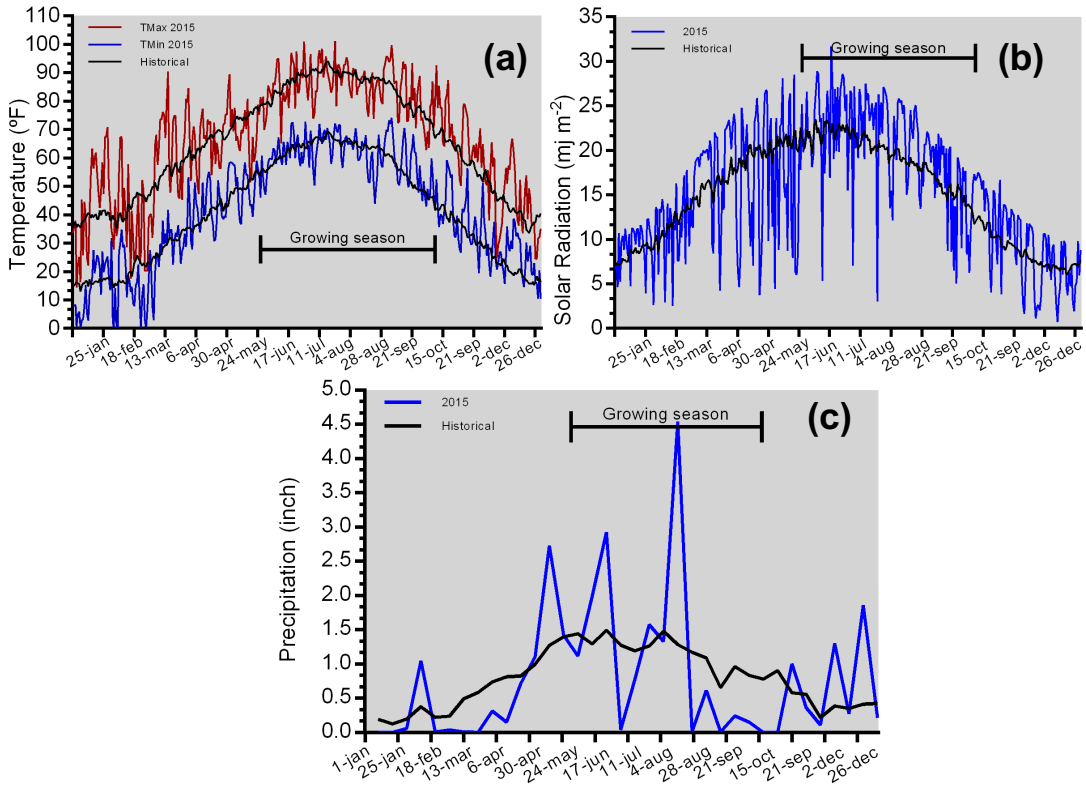

Figure 1. (a) Daily Maximum (red line) and minimum (blue line) temperatures for 2015 growing season and historical (black lines). (b) Daily Solar radiation for 2015 (blue line) and historical (black line). (c) Daily precipitation for 2015 (blue line) and historical (black line) at Scandia KS.

Results

Grain Yield

The average yield for the dryland condition was 34 bu ac^{-1} ranging from 28 to 38 bu ac^{-1}. (Fig. 2**)**. The irrigated condition yielded in average 73 bu ac^{-1}. In overall, the irrigated condition yielded 114% more than the dryland scenario. The minimum yield registered for irrigated was 62 bu ac^{-1} for CP, while the maximum was 82 bu ac^{-1} for AD treatment. There were statistical differences in yield between treatments. In both conditions (dryland and irrigated) treatment EI and AD showed the highest yields without presenting statistical differences. The PI treatment documented comparable yields relative to EI and AD for the dryland site; while an average yield gap of 7 bu ac^{-1} was recorded under irrigation when PI was compared against the EI-AD treatments (PI<EI-AD). At both water supply environments, CP and CF recorded the lowest yield, without statistically differing, relative to the rest of all treatments evaluated (Fig. 2).

In summary, in relative terms, dryland presented a larger yield gap from minimum to maximum yielding treatments (36%, CP-CF vs. PI-EI-AD) relative to the irrigated environment (24%, CP-CF vs. EI-AD). In absolute terms, dryland presented a measurable yield gap of 11 bu ac^{-1}; while at the irrigated site the gap was two-fold greater, 22 bu ac^{-1} (Fig. 2).

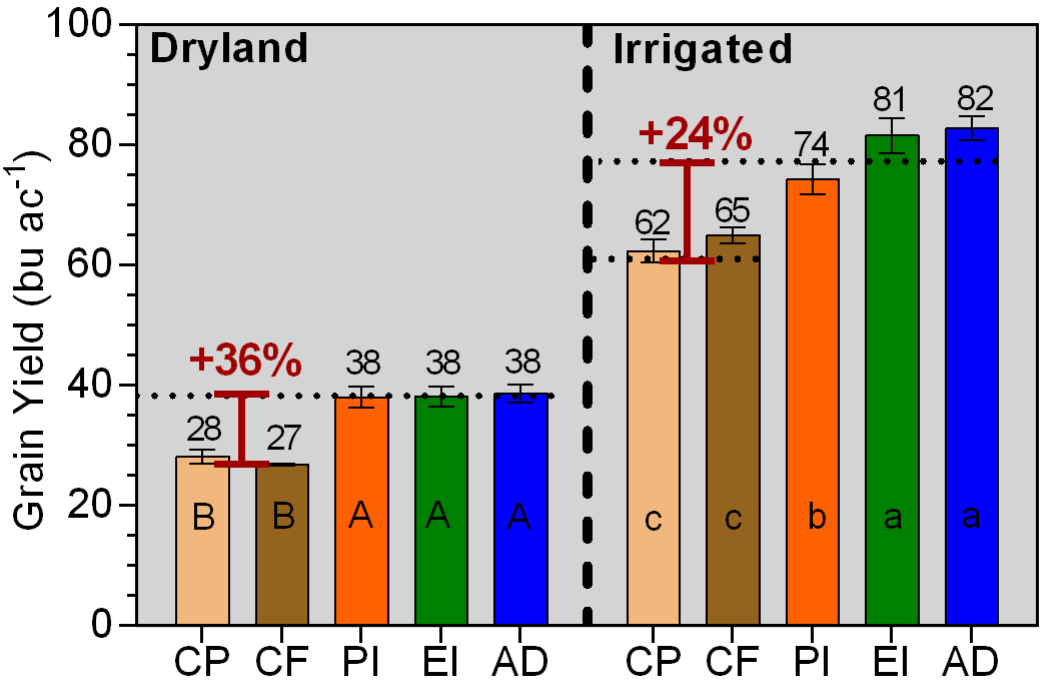

Figure 2. Soybean grain yield by treatment for dryland and irrigated conditions during the 2015 growing season, Scandia KS. Different letter shows statistical differences (*p<0.05*). CP=Common practices, CF= comprehensive fertilization, PI= production intensification, EI= ecological intensification (CF+PI), AD= advanced plus.

Total Aboveground Biomass and Nitrogen (N) Uptake

Total aboveground biomass and plant N uptake (both expressed in dry basis) at harvest for both irrigated and dryland conditions is shown in Figures 3 and 4, respectively. Overall across all treatments, average biomass accumulation at harvest was 13,230 lb ac^{-1}. Following the yield trend, there were statistical differences between treatments for both total aboveground biomass and N uptake. Management practices such as increasing plant density, narrow rows and following university fertilizer recommendations produced maximum total biomass and N uptake (EI-AD). For those treatments, average total aboveground biomass was 15,645 lb ac^{-1} with an overall plant N uptake of 400 lb N ac^{-1} (Fig. 3). Treatments planted at 30'' row spacing (CP-CF) presented a reduction in biomass accumulation but slightly higher grain harvest index (HI) than those planted at 15" row spacing (PI-EI-AD). Grain HI trait for irrigated conditions ranged from 0.30 (for EI) to 0.36 (for CF) units (Yield to total plant biomass ratio). Interestingly enough, grain HI lowered for treatments presenting high intensification-level (in parallel to superior total biomass accumulation; Fig. 3).

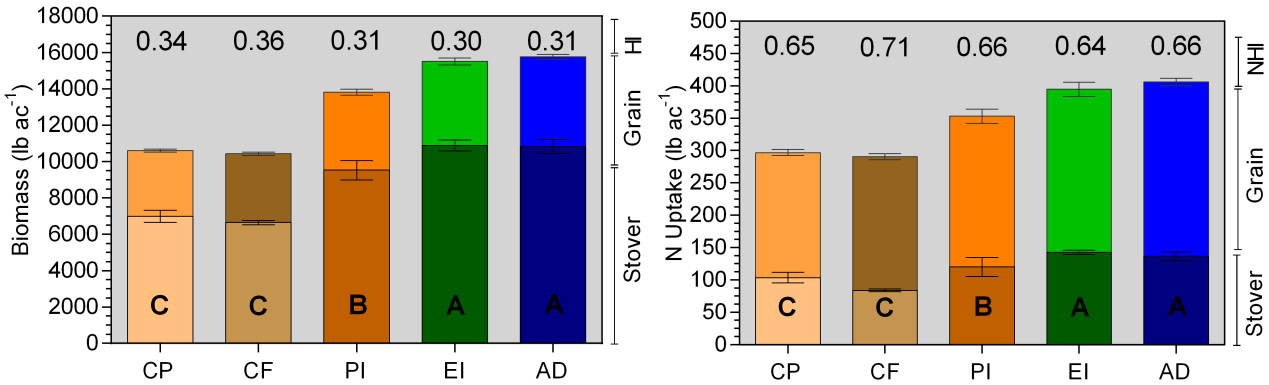

Figure 3. Irrigated soybean total biomass (left) and nitrogen uptake (right) during the 2015 growing season, Scandia KS. CP=Common practices, CF= comprehensive fertilization, PI= production intensification, EI= ecological intensification (CF+PI), AD= advanced plus.

For the dryland environment, biomass and N uptake showed different trends when compared under irrigation. Farming system approaches did not differ for the total aboveground biomass trait. In overall across all treatments, total biomass accumulation was 6,632 lb ac^{-1}, which was approximately two-fold lower relative to the total biomass recorded under irrigation (Figs. 3, 4). Grain HI variation was smaller as compared to the irrigation trial, varying from 0.29 (for CP) to 0.32 (for AD) units, but with opposite trend – increasing grain HI as the intensification increases (Fig. 4). Total N uptake followed a similar trend as previously documented for yields. Intensifying use of inputs allowed increasing total N uptake, averaging approximately 200 lbs N ac^{-1} for the PI, EI, and AD treatments. A 50 lbs N ac^{-1} reduction was documented for both CP and CF treatments in the total N uptake relative to its maximum value, attaining an overall final N uptake of 150 lbs N ac^{-1}.

The N partitioning coefficient (grain N to plant N ratio), NHI trait ranged from 0.64 to 0.71 for irrigated, while a narrow variation was documented for the dryland scenario, from 0.64 to 0.66 units (Figs. 3, 4). For both water supply scenarios, there was not a clear trend of either increasing or decreasing NHI as intensification level increases. Except for the CF treatment under irrigation, NHI was very stable across all treatments, ranging from 0.64 to 0.66 units.

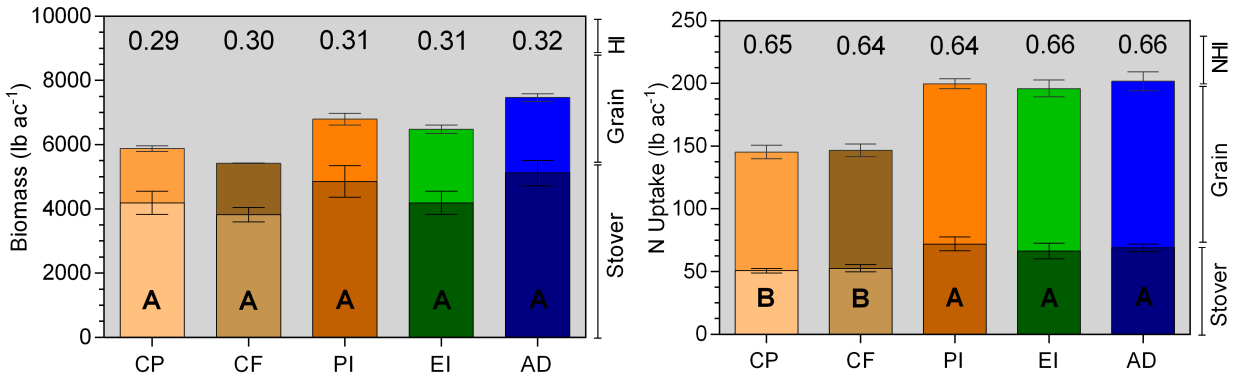

Figure 4. Dryland soybean total biomass (left) and nitrogen uptake (right) during the 2015 growing season, Scandia KS. Different letter shows statistical differences ($p<0.05$). CP=Common practices, CF= comprehensive fertilization, PI= production intensification, EI= ecological intensification (CF+PI), AD= advanced plus.