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Be On the Lookout for Sugarcane Aphid This Summer

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Last year many forage sorghum fields were heavily infested and damaged by Sugarcane Aphid (SCA) (Figure 1) – *Melanaphis sacchari* – feeding. Most calls came in around early July of 2016 with reports of aphids that were not well controlled using broad spectrum materials such as malathion, chlorpyrifos, or dimethoate. These calls triggered investigations which confirmed the invasion of the new species of aphid to California.

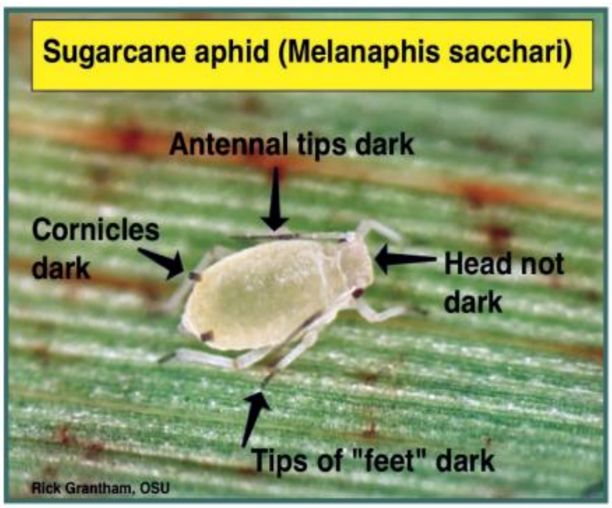

Figure 1: Distinguishing features of the sugarcane aphid. Borrowed from Knutson, Bowling, Brewer, Bynum, and Porter of Texas A&M, ENTO-035 4/16.

Based on field research and extension material from the US states in the South and Southwest, some basic guidelines for spotting, scouting, and treating SCA can be outlined for potential best management practices in our CA forage sorghum production system.

Identification: The SCA is distinguishable from the greenbug aphid – *Schizaphis graminum* – by the color of its body and cornicles, or "tailpipes" (Figure 2). The sugarcane aphid nymph body tends to be yellow to orange with black cornicles. Tips of the legs and antennae are also colored black. SCA can be found on the underside of leaves protected from direct sunlight. SCA and Greenbug are known to co-infest sorghum. It's unclear what initial infestation patterns within a field are, so scouting throughout the field – as opposed to only edges – until the insect is found is the best possible practice for now.

Hosts: SCA will infest, feed, and reproduce on sorghum, Sorghum-Sudan hybrids, Sudangrass, and Johnsongrass. It will not feed and reproduce on corn or small grains.

Damage: SCA feed by piercing and sucking phloem sap. Removal of photosynthates from the plant causes stunting, desiccation or early senescence of leaves, delayed or reduced grain fill, and even plant death. Additionally, honeydew – excrement from aphids – deposited on leaves will support the growth of sooty mold which will block sunlight from reaching leaves, further reducing photosynthetic efficiency of the plants. A small sample size (n = 16) of silage sorghum sampled at harvest from dairies in the San Joaquin Valley in 2016 as part of Merced Dairy Advisor Jennifer Heguy's research revealed some significant differences in feed value. Of the 16 dairies, 6 had no SCA observed and 10 were infested with SCA. Nutrient analyses of the harvests revealed that where the SCA were present crude protein was significantly increased, acid detergent fiber was significantly increased, ash was significantly increased, starch was significantly decreased, and non-fibrous carbohydrates were significantly decreased in harvests. For more information on this study, visit http://cestanislaus.ucanr.edu/files/258564.pdf to view the full presentation. Growers should consider the potential loss in feed quality of sorghum from SCA infestation when making pest management decisions.

Scouting: When plants reach the 4-5 leaf stage, begin scouting once per week. Choose four locations in the field, at least 25 feet from a field edge, and sample plants along a 50 foot transect into the field. The presence of honeydew is a good indicator of aphid presence. At each sampling location, examine the underside of upper and lower green leaves of 15 to 20 plants. When SCA are detected, begin scouting twice per week until a treatment threshold is reached. It is prudent to also examine nearby locations known to host Johnsongrass for SCA presence.

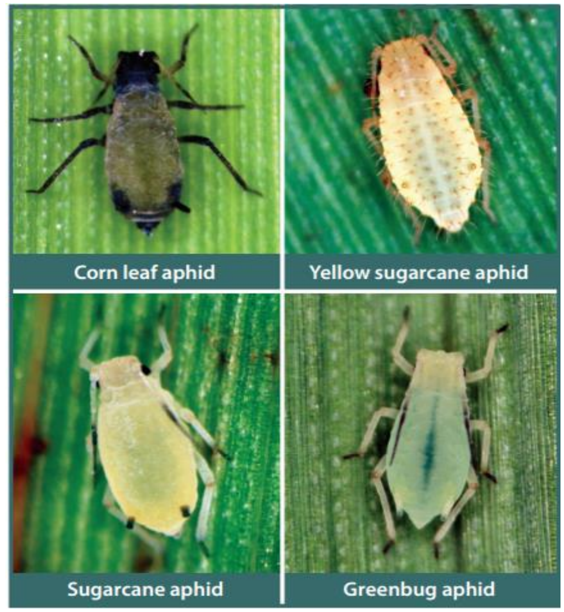

Figure 2: Visual comparison of the SCA to other sorghum inhabiting aphids. From Knutson, Bowling, Brewer, Bynum, and Porter of Texas A&M, ENTO-035 4/16.

Treatment threshold: Two established treatment thresholds exist that were developed for grain sorghum in Texas. The most conservative of the two is described here and is recommended for the interim since no research information currently exists on the potential economic damage of SCA to forage sorghum. These are the modified steps to determine insecticide treatment timing:

1. Select 5 random plants from each of 4 sampling locations.
2. Examine an upper and lower green leaf from each plant (40 leaves total), and estimate the total number of aphids on each leaf.
3. Calculate the average number of aphids per leaf (total aphids counted / 40 leaves = average aphids / leaf).
4. When the average number of aphids per leaf reaches 50, treatment should generally be made within a week.

This treatment threshold is especially conservative considering research shows that SCA infestation at early stages of sorghum growth are more damaging to yield than infestations at later stages when left untreated. So, it's also advisable to consider infestation timing in crop time to decide whether an early harvest to avoid excessive losses is more cost effective than an insecticide treatment.

Insecticide treatment options: A significant number of CA sorghum growers have opted to purchase insecticide treated seed for the 2017 growing season. Imidacloprid or clothianidin coated seed have been shown to offer protection for up to 40 days after planting. This tactic will probably offer the greatest protection to later planted sorghum, but seed treatment for any planting date is not discouraged since infestation timing is not well understood in CA yet.

For in-season insecticide treatment, the University of CA Cooperative Extension is discouraging the use of broad spectrum materials such as malathion, dimethoate, or chlorphyrifos to control SCA. Of the two insecticides that have shown acceptable efficacy in SCA control in sorghum – flupyradifuron and sulfoxaflor – only flupyradifuron is registered for use on sorghum in CA. Always consult the specimen label for use requirements and a Pest Control Advisor for advice and recommendations when considering an insecticide treatment.

Cultural control options: Cultural practices that promote plant health and vigor will provide a strong basis of control against SCA. Early planting into adequate moisture when soil temperatures are at least 60 degrees F at a targeted population of 100,000 plants/acre is highly recommended. Control weeds, especially Johnsongrass, to promote early plant vigor. Consult a seed dealer for information on SCA tolerant or resistant varieties of sorghum. Research has shown significant grain yield protection exists from planting SCA resistant varieties. Maintain adequate fertility and soil moisture to avoid nutrient deficiencies and drought stress.

Local resources: For more information on SCA and sorghum production, visit http://cestanislaus.ucanr.edu/Agriculture/Dairy_Science/Sorghum_Silage_for_California_Dairies_2017/.

For general information on SCA, visit http://www.sorghumcheckoff.com/newsroom/2016/03/28/sugarcane-aphid/.

For information on sorghum varieties, nutrient, and water requirements, visit http://sorghum.ucanr.edu/.

2016 Tulare County Blackeye Cowpea Strip Trials

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Trial conditions: In the summer of 2016, four strip trial sites in Tulare County were established to test yield and resistance to Fusarium Wilt of Blackeye Race 4 – *Fusarium oxysporum* f. sp. *tracheiphilum race 4* –in three experimental lines. Three sites were located southwest of Tulare, and the fourth was located south of Farmersville (Table 1).

Table 1. Strip trial site characteristics

	Tulare 1	Tulare 2	Tulare 3	Farmersville
Soil series - texture	Colpien - loam	Colpien - loam	Crosscreek – loam/fine sandy loam; Colpien - loam	Nord - fine sandy loam
2015-16 Crop rotation	Cotton-Wheat-Beans	Cotton-Wheat-Beans	Cotton-Winter fallow-Beans	Winter wheat-beans
Row spacing	38”	38”	38”	30”
Inoculated?	Yes	Yes	Yes	No
Planting date	5/25/16	5/28/16	5/11/16	6/25/16
Cutting date	9/26/16	8/18/16	9/23/16	10/4/16
Threshing date	10/11/16	9/3/16	10/6/16	10/25/16
Bean flushes	double	single	double	single
Herbicide	Dual Magnum + Treflan	No pre-emergent	No pre-emergent	Dual Magnum + Treflan

At each site, strip plots six beds wide by the length of the field (from 900 – 1,350 ft.) were planted to moisture with the growers’ own planters. Each strip was planted only once at each site, so they were not replicated within a field. Targeted seeding rates were approximately 60,000 seed/acre. The three experimental varieties listed in Table 2 were tested and compared to the growers’ field variety, CB-46.

Table 2. Experimental line and check variety characteristics

	CB-46	CB-46-RK2	10K-29	N2
Seed qualities	Medium size (0.21 g/seed), cream colored, no splits, non-leaking eyes	Slightly smaller than CB-46	Larger than CB-46	Similar or slightly larger than CB-46
Root Knot Nematode resistance	Carries Rk gene against *M. incognita*	Better than CB-46 under more virulent nematode pressure	Similar to CB-46	Better than CB-46 under more virulent nematode pressure
Fusarium Wilt race 4 resistance	No	To be determined	Yes	To be determined
Lygus tolerance	No	No	No	Slightly better than CB-46

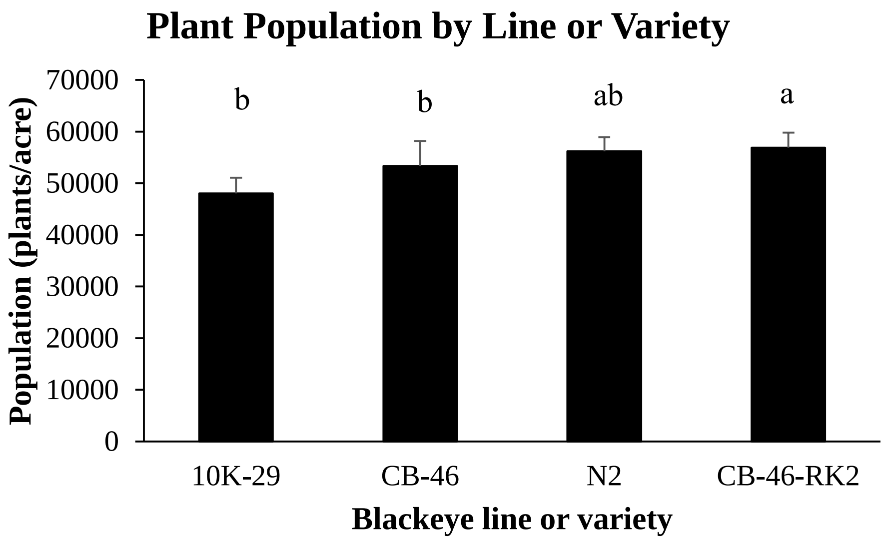

Figure 1. Plant population varied significantly by line or variety. Error bars represent the standard error of the mean. Mean bars below identical lower case letters are not significantly different (α = 0.05)

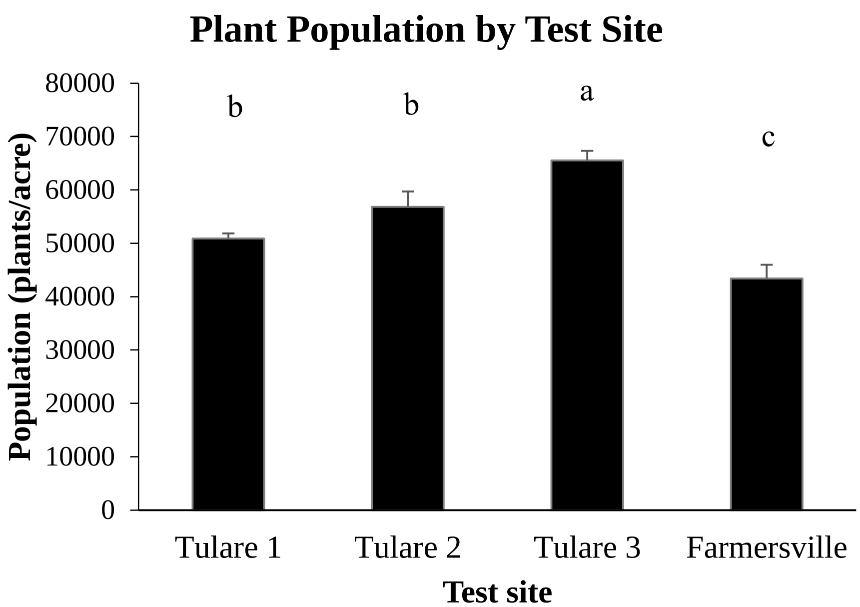

Figure 2. Plant population varied significantly by site. Error bars represent the standard error of the mean. Mean bars below identical lower case letters are not significantly different (α = 0.05).

Stand density: Replicated stand counts were performed at each site when plants reached approximately 3-6 trifoliate leaves. There were statistically significant differences in plant population between plant lines and between trial sites, but there was no significant interaction between site and plant line. Line 10K-29 had the lowest average population and was similar to that of CB-46. Cultivar CB-46 had a population that was similar to lines N2 and CB-46-RK2, the latter two being significantly higher than the population of 10K-29 (Figure 1).

Plant population at the Farmersville site was significantly lower than all other sites, probably a result of having trouble germinating the crop. Soil moisture was variable at planting so a relatively large percentage of seeds did not germinate until after the first in-season irrigation. The "Tulare 3" site had a population significantly higher than all others, and this is likely due to relatively high seeding rates and good stand establishment practices (Figure 2). Although there was no statistically significant interaction of test site and Blackeye line on the plant population, there were apparent differences (Figure 3). Line 10K-29 regularly had a lower stand density except at the Tulare 1 site where the population was equal to line N2 and slightly greater than the commercial cultivar CB-46. Cultivar CB-46 population was greater than all other lines at the Tulare 2 and 3 sites but not at the Tulare 1 and Farmersville sites. Despite significant differences between sites and between Blackeye lines, there was no statistically significant relationship between plant population and yield when a regression analysis was performed ($p>0.05$). This is in agreement with typical growing patterns, as Blackeyes have a strong tendency to fill the canopy by more prolific branching during early vegetative growth which compensates for the number of fruiting nodes per unit of area.

Growing season: The 2016 growing season was not excessively warm, nor were night-time temperatures in the region sufficiently high to cause significant damage at bloom set. No major precipitation events occurred within the growing season for either site, but about 0.6" of rain was recorded on May 5 near the Tulare sites, several days prior to the earliest planting. Otherwise, conditions were relatively dry all year.

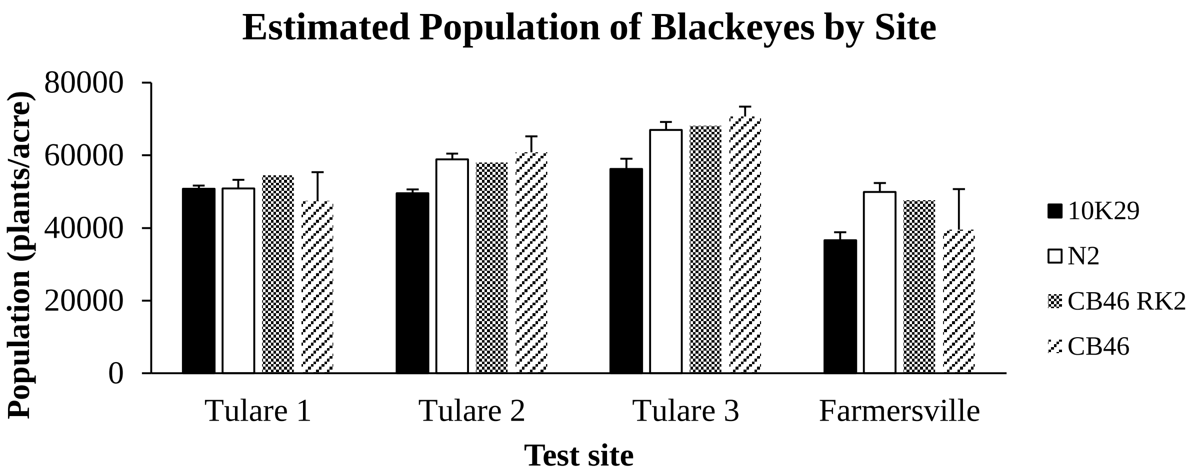

Figure 3. Stand density of different lines between individual sites. Error bars represent the standard deviation. No differences were statistically significant interactions between site and Blackeye line (p = 0.068). That is, the relative plant populations between lines was similar at each site.

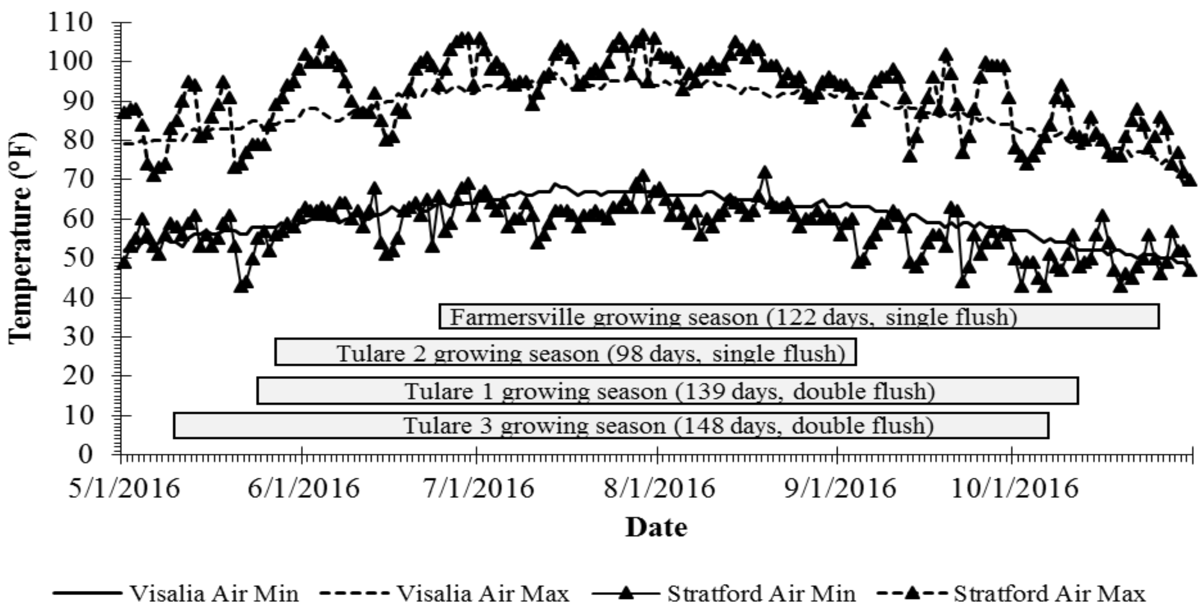

Figure 4. Growing seasons of individual sites overlaid on daily high and low air temperatures for the region.

Small populations of armyworm developed at two of the Tulare sites early in the season (June), but were quickly suppressed before any economic damage occurred. There was no significant lygus pressure for any of the sites. Fusarium wilt race 4 of Blackeye – *Fusarium oxysporum* f. sp. *tracheiphilum* – was detected in the western Tulare region, but was not detected in the Tulare 1, 2, or 3 experimental sites. Fusarium wilt of Blackeye was detected in the Farmersville site, but the race was not identified. Root knot nematode (RKN) – *Meloidogyne spp.* – galls were detected at the Farmersville site on the field variety, CB-46, which also exhibited infrequent, scattered incidence with low to moderate severity of Fusarium wilt symptoms. In the Tulare 1, 2, and 3 fields, low levels of Rhizoctonia stem canker – *Rhizoctonia solani* – were detected, but were not of economically concerning levels.

At the "Tulare 2" site, there was a low performing area of the field where plants were severely stunted early in the growing season and never recovered. Experimental line 10K-29 was notably more afflicted than any other line or cultivar CB-46 (Figure 5). Soil tests for pH, salinity, texture, and macro- and micronutrients were performed on the top foot of the afflicted area and compared to normal area of the field in an attempt to determine the cause of the problem. No notable differences in these soil characteristics elucidated a cause, except a lime fizz test revealed a much higher level of lime in the afflicted area relative to the normal area. Google Earth satellite imagery revealed a consistent hot-spot of low plant density in this area of the field. Although the cause has not been determined, it may be related to lime-induced chlorosis potentially due to iron deficiency as iron is less soluble under pH neutral to alkaline and calcareous conditions.

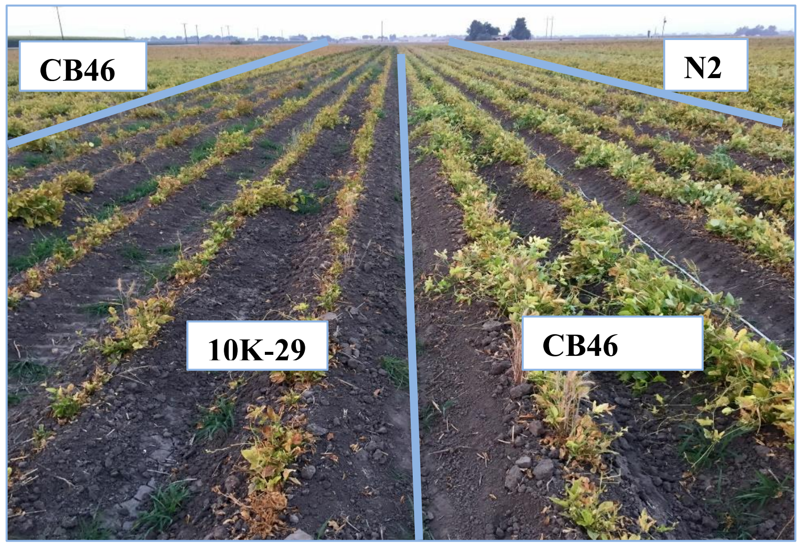

Figure 5. Experimental lines differentially affected by high lime, poor performing area of field at "Tulare 2" site.

__Harvest:__ Yields, of each line between sites is shown in Figure 6. At all except the "Tulare 2" site, line 10K-29 tended to yield less than the three other lines. The exception at "Tulare 2" was that line CB-46-RK2 also yielded relatively low. However, despite these apparent differences, when yields of each line were statistically compared to one another, there were no significant differences (data not shown). Yield data between single flush and double flush sites were separated and analyzed for differences to control for variability between a low yielding and a high yielding production system. Still, no significant differences in yield between lines were found at either the single flush or double flush sites (data not shown). However, yields at the double flush sites were significantly higher than yields at the single flush sites ($p<0.001$). Growers are encouraged to weigh the options of growing for one or two flushes of Blackeyes. Cost of water, crop rotation schedule, projected price for beans, and typical yield goals should all be considered when deciding between single and double flush.

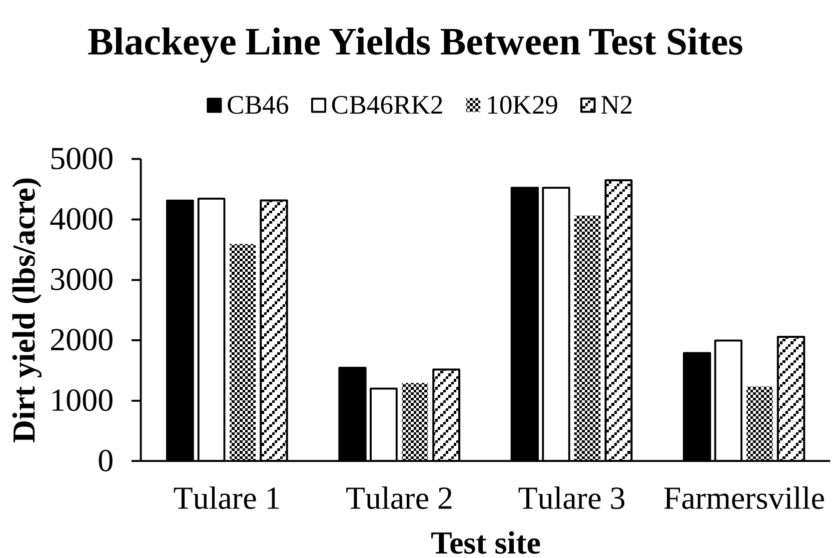

Figure 6. Yields of individual lines of Blackeye tested at each Tulare County site.

Clean weights for individual lines were not obtainable because lots from individual test sites were bulked at the warehouse before cleaning. However, cleanout values between sites ranged from 8-12%. One-hundred seed weight, a measure of seed size and/or density, was notably different between lines, although not statistically significant. One-hundred seed weight between sites, however, were significantly different ($p=0.005$) (Table 3). Seed size in a double flush system is often a function of plant maturity at the irrigation cutoff to promote plant senescence and allow soil to dry enough for wheel traffic. In a typical double flush system, the final irrigation should be able to carry the crop 1.5 to 2 times as long as the typical irrigation interval. Growers on fine soils with high water holding capacities will be challenged to determine this stage and the amount of water to apply, as they are subject to a longer drying period which inherently has more day to day variability in air temperatures. Growers on coarser soil will be challenged season-long to avoid a “feast or famine” situation with plant available water, but have more flexibility in irrigation cutoff due to a quicker dry down time.

Table 3. One-hundred seed weights of Blackeye lines between test sites.

Blackeye line	Test site				*Line avg.*	*SD*
	Tulare 1	**Tulare 2**	**Tulare 3**	**Farmersville**		
N2	19.1	19.4	18.7	21.0	*19.6*	*0.87*
CB-46	19.4	19.6	19.2	20.3	*19.6*	*0.41*
CB-46-RK2	16.7	19.0	17.4	21.5	*18.7*	*1.84*
10K-29	19.7	20.8	17.4	23.0	*20.2*	*2.02*
Site avg.	*18.7 ab*	*19.7 ab*	*18.2 a*	*21.5 b*		
SD	*1.37*	*0.77*	*0.92*	*1.14*		

Values in the “Site avg.” row are statistically similar if followed by similar lowercase letters at $\alpha = 0.05$.

An interesting, yet statistically insignificant (*p = 0.06*), relationship between plant population and 100 seed weight was noted (Figure 7). It appears that between 35,000 and 70,000 plants per acre, there is about a 1 gram decrease in 100 seed weight for every 10,000 plant per acre increase. This potential relationship could be explored in replicated trials, and it should not be taken as truth from this data alone, as many other factors could have contributed to this variability.

An interesting difference between lines observed at harvest was in the integrity of the straw after threshing. The straw of CB-46 and line N2 were notably more physically broken down after threshing and spreading than were the straws of lines CB-46-RK2 and 10K-29 (Figure 8). For one custome harvester, this difference created a nuisance during spreading, as straw was not spread evenly and had a tendency to catch in the spreading equipment. Further, it was noted that it could present a safety hazard to people working around the equipment as long chains of straw were observed spinning several times in the spreader before being released to the field, acting like a whip. One question for the cooperating growers was whether the difference in straw quality would impede cultivation operations to incorporate the straw into the soil or if the decomposition of the straw would be slow enough to impede later operations like bed shaping or planting. All of the growers were aware of the issue, and none reported back any further problems with the longer straw from these two lines

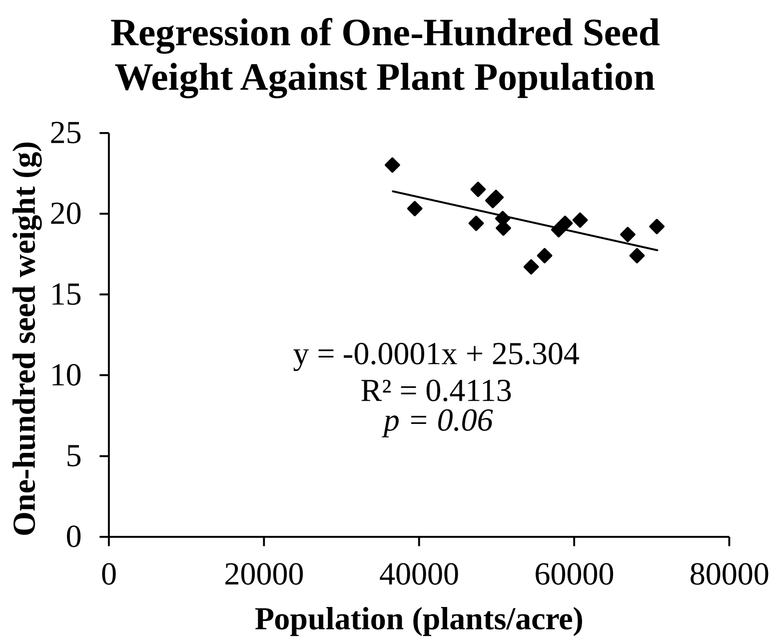

Figure 7. Regression analysis and linear model fit of 100 seed weight over plant population. Although statistically insignificant, there appears to be a subtle relationship between seed weight and plant population.

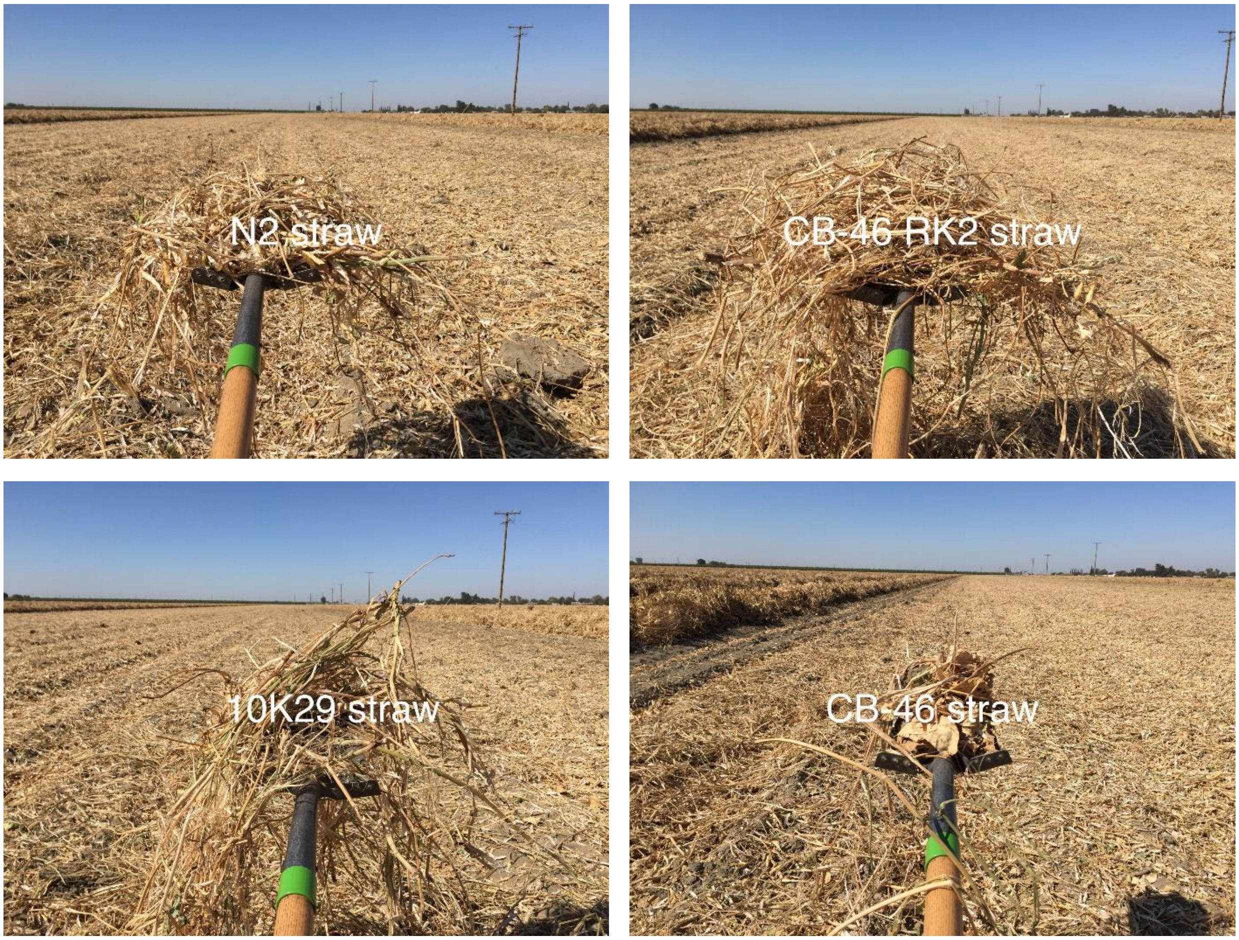

Figure 8. Quick look at the straw structure of the four lines tested at each site. Note the shorter, less tangled nature of the CB-46 and N2 straws compared to 10K-29 and CB-46-RK2. This posed a minor nuisance during threshing, but not later during cultivation.

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Suggestions for further reading:

1. Hall, A. E. and C. A. Frate eds., 1996: Blackeye Bean Production in California, Regents of the University of California Division of Agriculture and Natural Resources, publication #21518.
2. Roberts, P. A., Huynh, B. L., Clark, N. E., Matthews, W. C., and Frate, C. A., 2016. Blackeye Varietal Improvement – 2016 Progress Report. *In* University of California Dry Bean Research 216 Progress Report published by California Dry Bean Advisory Board and available at http://beans.ucanr.org/.
3. Frate, C. A., Klonsky, K. M., and De Moura, R. L., 2013. Sample Costs to Produce Blackeye Beans Double Cropped: San Joaquin Valley – South, Tulare County. University of California Cooperative Extension, available at https://coststudies.ucdavis.edu/current/
4. Frate, C. A., Klonsky, K. M., and De Moura, R. L., 2013. Sample Costs to Produce Blackeye Beans Single Cropped: San Joaquin Valley – South, Tulare County. University of California Cooperative Extension, available at https://coststudies.ucdavis.edu/current/

Salinity origins and management in agronomic cropping systems:
A case for periodic leaching- Part I

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Mineral salts are present in all irrigation waters and soils in concentrations that vary depending on factors such as their geologic origin, position on the landscape and past soil and water management practices. Depending on their composition and concentration, mineral salts can interfere with the plants ability to take up water, while some specific elements can build up to a point that they become toxic to plants. In some cases, salt buildup in soils can impede the movement of water through the soil further effecting crop water uptake and productivity. These are all good reasons to better understand the presence of salts in irrigated agricultural systems and why a regular effort to monitor salinity levels in some irrigation waters and soil profiles can lead to much improved agronomic crop performance.

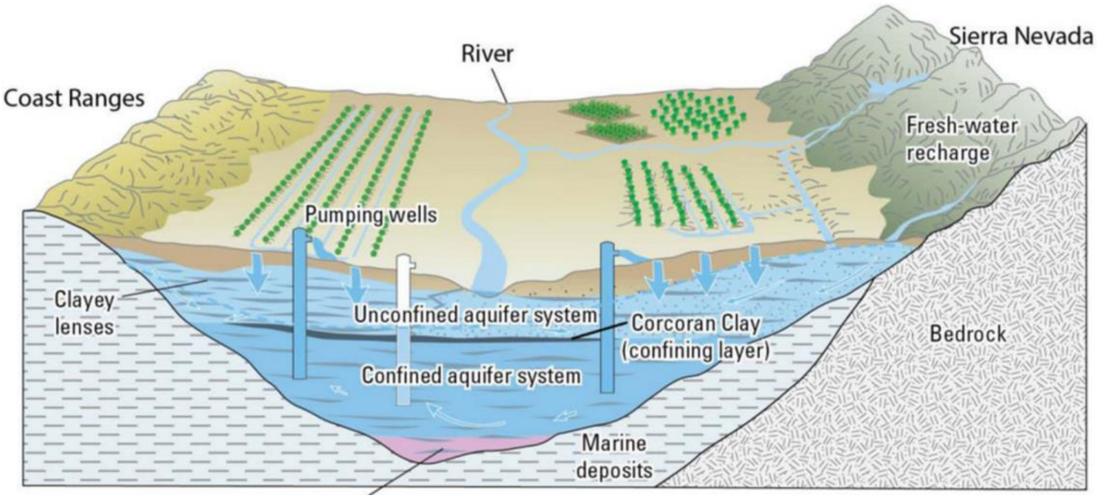
The primary cations in both irrigation waters and soils include calcium (Ca^{2+}), sodium (Na^{+}), magnesium (Mg^{2+}), and potassium (K^{+}) while the primary anions include chloride (Cl^{-}), sulfate (SO_4^{2-}), and bicarbonate (HCO_3^{-}). Other salts can also be of concern regionally including the carbonate ion (CO_3^{2-}) present under high pH conditions (above 8.0) and boron (B) found soils and irrigation waters. Though boron is a micronutrient required by all plants, boron deficiencies in plants are less common than plant toxicities of boron, sodium or chloride in reducing crop productivity. The concentrations of individual salt constituents can be important in salinity evaluations and are often expressed in milliequivalents per liter (meq/l) or milligrams per liter (mg/l) sometimes expressed in parts per million (ppm).

Oftentimes the single most important salinity measurement is that of total salinity also referred to as total dissolved solids (TDS) and expressed in mg/l or ppm. One of the benefits of this measurement is that it can be estimated inexpensively by measuring the irrigation water or soil extract's electrical conductance (EC) properties. As the salinity of a solution increases, so too does its ability to conduct and electrical current and the irrigation or soil extract can be expressed in units of conductance, most commonly deciSiemens per meter (dS/m) or as millimhos per centimeter (mmhos/cm) and are numerically equivalent. One dS/m is approximately equivalent to 640 mg/l (ppm) in solutions below 5.0 dS/m. Plant tolerances to soil salinity are similarly expressed in terms of soil extract EC properties.

Regional irrigation water salinity: There is commonly a distinction between the salinity of irrigation waters derived from groundwater versus those of surface water sources. The distinction comes from the fact that most surface water components come from streams and rivers that were more recently released from watershed headwaters more directly sourced from the runoff of snowmelt and rainfall whereas groundwater has oftentimes been in direct contact with dissolvable soil minerals and geologic sediments for many years, decades or millennia. Like surface waters, sources of groundwater also originate from rivers, streams and canals, but also come from water percolating through surface soils that contain water consuming plant life. It is through the process of evapotranspiration that large volumes of soil water are taken up by the plant together with only small quantities of salt leaving behind the large majority of soluble salts in the soil profile to accumulate over time.

Another factor influencing the salinity level in groundwater is the type of parent material in the geologic materials. Groundwater origins of the eastern central valley are derived from highly insoluble granites and granitic alluvium deposited long ago from the Sierra Nevada mountain range. It is only when water has a long residence time in those sediments that salinity levels can rise. The courser sediments found in the eastern valley allows water to percolate through permeable aquifers that are higher in elevation eventually migrating to the lower lying portions of the valley. This difference in residence time partially explains why we see groundwater salinity levels rise as water migrates from east to west. Groundwater salinity levels are also much lower in areas more directly influenced by regular stream or canal flow. Generally, the water quality of eastern valley aquifers ranges from 100 to 500 mg/l and is considered to be very good water quality for most irrigated crops.

Figure 1. Valley cross section



DWR, 2016

Groundwater origins of the western valley are primarily derived from the sedimentary rock of the inland coastal ranges in which soils are largely composed of alluvium of sandstone, siltstones and shales once deposited in a shallow seafloor environment. These sediments of saltwater origin help explain why salinity levels of the unconfined (surface) aquifer are much higher in salinity and typically too saline to be used as an irrigation source. Western valley growers instead use the higher quality groundwater found much deeper and located below a confining clay layer that separates the unconfined aquifer from the lower confined aquifer. Groundwater wells that source their water from the aquifer below the Corcoran clay, have much lower salinity as the water origins are connected with the Sierra Nevada drainage.

Generally, water quality above the Corcoran clay is above 1,800 ppm and often exceeds 3,000 ppm in poorly drained landscape positions and is not considered suitable for most irrigated agricultural needs. Sub-Corcoran clay water on the other hand ranges from 500 to 1,800 mg/l but has experienced a regular decline in quality as its use has increased in recent years.

Table 1. Guidelines for interpretations of water quality for irrigation

Potential Irrigation Problem		**Units**	**Degree of Restriction on Use**		
			None	**Slight to Moderate**	**Severe**
Salinity*(affects crop water availability)*[2]					
	EC_w	dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)				
	TDS	mg/l	< 450	450 – 2000	> 2000

And while surface water quality also has a significant range in TDS and composition, total salt levels are generally much lower than in groundwater systems. Many eastside valley streams and canals deliver water that is between 25 and 150 mg/l while state and federal water delivery systems on the west side generally range from 200-500 mg/l. Irrigation water quality and quantity plays a pivotal role in managing soil salinity characteristics because of the large volume of salts that can potentially be deposited in the soil during irrigation activity and because of waters ability to move salts within the soil profile. To better appreciate the amount of salt that can accumulate in soils, a water with a modest EC of 1.0 dS/m will deposit about 1,740 lbs. for every acre foot applied. Therefore, if we assume an application of 3 acre feet for a crop, this equates to 5,222 lbs. of salt per acre deposited to the soil for that season.

Soil salinity: Because soil salts are highly soluble, they tend to move with water and will accumulate if not leached. There are a few situations in irrigated agricultural systems that especially foster high soil salinity conditions in soils. Perhaps the most obvious is the irrigation system that regularly uses a high TDS water source. It does not take long in these systems to accumulate salts in the soil profile and conditions such as high rates of evapotranspiration, regular deficit irrigation practices and plantings of salt sensitive crops will hasten the rate at which crop productivity will be impacted. Areas of poor soil drainage can also lead to salt accumulation in soils systems by reducing or eliminating the ability of the salts to move below the root zone. These systems are common where high water tables exist and are sometimes associated with clay layers that perch water thereby restricting downward movement of water.

Table 2. General Classification of salt and sodium affected soils.

Criterion	Normal	Saline	Sodic	Saline-Sodic
EC_e (dS/m)	<4	>4	<4	>4
SAR_e	<13	<13	>13	>13

Occasionally surface soil conditions can exist in which soil structure is compromised as a result of unfavorable soil or water quality and water movement through the soil is limited. Under these conditions, soil aggregates can break down leaving a dispersed (or deflocculated) soil condition where fine soil particles fill in the spaces between soil voids leading to poor soil infiltration rates. Unless improved soil or water chemistry conditions are met these soils will have limited infiltration and deficit irrigation conditions will limit any movement of salt below the root zone.

Part 2 will include discussion on the accumulation of salts in soils, plant salinity tolerances and approaches to manage soil salinity by leaching soil salts.

References:

Ayres, R.S. and D.W. Westcot. 1976. Water Quality for Agriculture. Irrigation and Drainage Paper No. 29. Food and Agriculture Organization of the United Nations. Rome.

Field Crop & Nutrient Notes

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