UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Palo Verde Valley Update

Winter 2024

One thing of which we can be sure, no two years are exactly alike. Thus far in 2024 we are at almost 4x the amount of moisture received locally compared with the winter of 2023. There seems to be almost that amount of new chemistries, primarily biological based, available for agricultural usage. Aphid species complex in alfalfa is again currently dominated by the presence of pea aphids, which last year were still present in high numbers in April.

This issue of the Palo Verde Valley Update contains information on commercially available bacterial products that can fix nitrogen for crops to utilize, provides a review of winter alfalfa diseases that may be encountered, shares local research results on dehydrator onion yield responses to various biostimulants, and a few other things.

Wishing each of you a successful 2024 production year. Cheers!

In this issue

New/Recent Nitrogen Fixing Bacterial Products for Agriculture

Michael D. Rethwisch, UCCE-Riverside County, Palo Verde Valley office

Most agricultural producers are well aware that current nitrogen prices have been erratic and reaching at some fairly high levels the past 2 years. Although the current nitrogen price is now somewhat lower than in the recent past, there is still concern that prices will continue to increase due to repercussions from the Ukraine-Russia conflict (Schnitkey et al., 2022).

Due to the higher prices, there is much interest in biological products that can contribute nitrogen as part of the production process. Increased research focusing on nitrogen fixing bacteria over the past several decades has resulted in several new products across a range of bacterial genera that are now commercially available for usage in agriculture, and are no longer restricted to just legumes.

With multiple new products now available for usage in agriculture, many people may be surprised to learn these new/recently available bacterial products function very differently compared to the nitrogen fixing nodulating bacteria (sometimes referenced as legume nodulating bacteria or LNB) historically utilized in agriculture, and represent a wide range of bacterial genera and species that most people have not previously encountered.

LEGUME NODULATING BACTERIA

Local legumes such as alfalfa have long been known to have a symbiotic relationship with the bacterium *Sinorhizobium meliloti* (also referred to as *Rhizobium meliloti*). This bacterial species creates nodules on alfalfa roots, after the plants have reached 3-4 leaves in size, and is estimated to make slightly over 300 lbs./acre of nitrogen available via fixation.

Each individual legume species is usually paired with a specific symbiotic nodulating bacteria species and strain for nitrogen production, with the amount of nitrogen produced differing by legume species.

In addition to the *Sinorhizobium* used in alfalfa, two other legume nodulating bacteria (LNB) genera are commercially used in U.S. agriculture – *Bradyrhizobium* and *Rhizobium*. There is often additional specificity for the bacterial stain within the bacterial species and the legume species.

These bacteria can capture and fix significant amounts of nitrogen for their host plants.

Table 1. Amount of nitrogen fixed by symbiotic bacteria in various legume crops.

		Estimates of nitrogen (lbs./acre)	
Crop	**Genus / species**	**Low**	**High**
Alfalfa	*Sinorhizobium meliloti*	44	308
Cowpeas	*Bradyrhizobium*	44	132
Dry Beans	*Rhizobium leguminosarum* bv. *phasioli*	50	150
Garbanzo Beans	*Bradyrhizobium*	25	81
Peas	*Rhizobium leguminosarum* bv. *viciae*	53	305
Soybeans	*Bradyrhizobium japonicum*	53	265

(estimates from Erker and Brick, 2014)

FREE LIVING SOIL BACTERIA

AZOTOBACTER

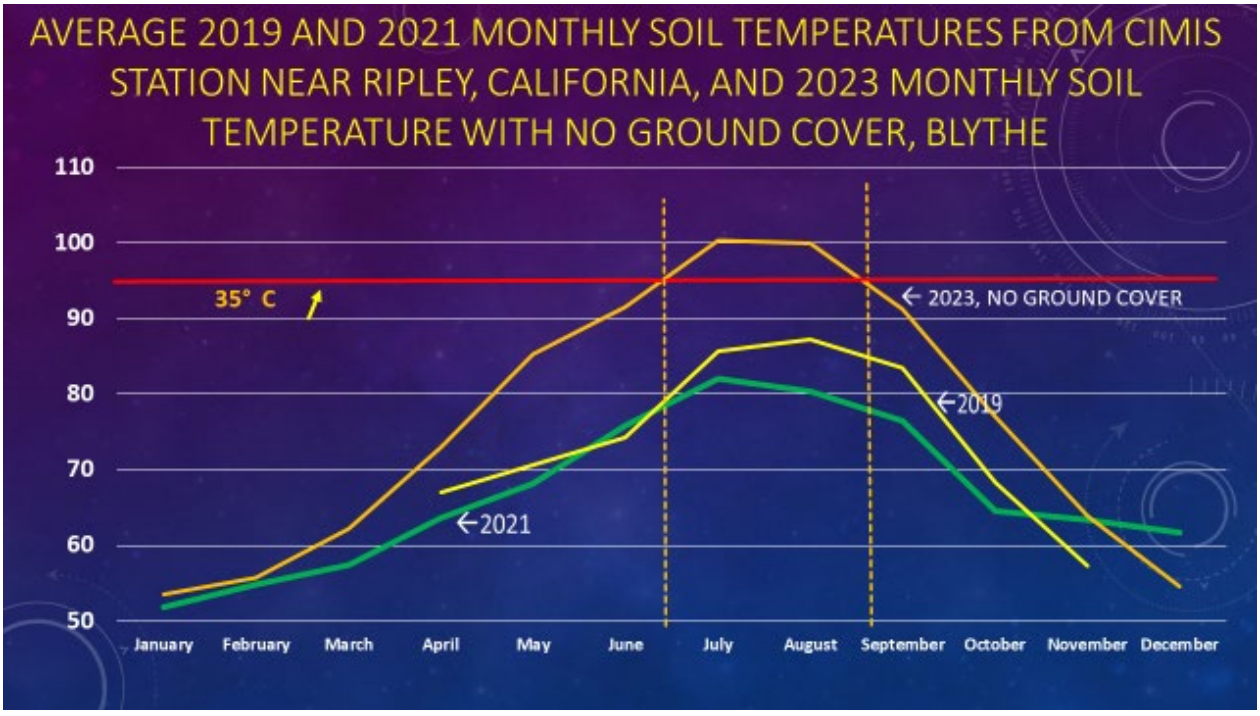
The past several years have noted increasing awareness and usage of *Azotobacter*. This genus is not new, being discovered in 1901, with *Azotobacter chroococcum* noted as first aerobic free-living nitrogen fixing bacteria.

The nitrogen fixing action is very different than that of the *legume nodulating bacteria which provide nitrogen after they have infected the root and fix nitrogen there at that location versus Azotobacter,* which live freely in the soil and do not colonize roots. *Azotobacter* bacteria utilize atmospheric nitrogen gas for their cell protein synthesis. This cell protein is then mineralized in soil after the death of *Azotobacter* cells, which then becomes available nitrogen for crops. Research has indicated that this species is capable of fixing an average of 17.8 lbs. of nitrogen/acre per year (Kizilkaya, 2009).

Azotobacter chroococcum product labeling from one supplier (*https://doraagri.com/product/azotobacter-chroococcum/)* notes that this bacterial species grows best when temperatures are 77-86°F, with growth inhibited when temperature is lower than 50°F or higher than 104°F.

While air temperatures may exceed these levels, soil temperatures for most of the year in the low desert are within these ranges. Azo*obacter chroococcum* is sensitive to acidic pH, with best pH value ranging from 7.4-7.6 (which should be a good fit in the low desert), but sensitivity to high salts is known.

While the average summer soil temperatures from the Ripley CIMIS weather station (shown below for 2019 and 2021), don't exceed these thresholds, higher temperatures should be expected for bare soils, especially in the top 4 inches. While average temperatures are shown, daily peaks beyond these should be expected from solar radiation.



A very interesting aspect of this species is the production of multiple beneficial plant growth substances (primarily hormones and amino acids) which have been documented to help increase plant growth far beyond the levels due to nitrogen alone. These aspects are thought by some to be more beneficial for plant growth than the nitrogen fixed in the soil by *Azotobacter*.

AZOSPIRILLUM

Azospirillum bacteria have been studied among the associative symbiotic nitrogen fixers because of their association with different grasses. Currently, 17 species of *Azospirillum* have been reported and among them, *Azospirillum lipoferum* and *Azospirillum brasilense* are the most studied (Kour et al., 2020). These species have been isolated from the soil as well as from the aerial parts of plants having nitrogen-fixing abilities. Accolade® (Verdesian Life Sciences) contains the free-living, nitrogen-fixing bacteria *Azospirillum brasilense*, which can be used on more than just grass crops, and in different methods (root drenches, etc.)

Apart from nitrogen fixation *Azospirillum* bacteria can also produce various plant hormones such as indole acetic acid (IAA), cytokinins, and gibberellins. It has been reported that *Azospirillum* also helps plants to survive during stress conditions by promoting changes in cell wall elasticity and osmotic adjustments (Groppa, Benavides, & Zawoznik, 2012). Saritha and Tollamadugu (2019) reported this bacterial species can produce 18-36 lbs. nitrogen/acre in addition to the various plant hormones.

NON–LEGUME ROOT COLONIZING BACTERIA

KLEBSIELLA (Raoultella), KOSAKONIA

There are several non-legume nitrogen fixing bacteria that colonize roots that are now commercially available. These bacteria are available in products such as ProveN, ProveN40, and ReturN. These products are marketed by Pivot Bio, and target usage on grass grain/silage crops (corn, corn silage, sorghum, wheat) and are usually applied at planting or directly to the seed prior to planting.

ProveN was the first product of these products released by Pivot Bio. It contained the bacteria *Klebsiella variicola* strain 137, and was expected to provide 20 lbs./acre of nitrogen. The marketplace has since had ProveN 40 become available, which is expected to provide 40 lbs./acre of nitrogen. ProveN 40 contains two bacterial species (*Kosakonia sacchari, Klebsiella variicola).*

ReturN contains *Klebsiella variicola,* which is expected to provide up to 25 lbs./acre of nitrogen. It is marketed for on-seed or in-furrow applications for wheat, sorghum and other small grains.

The response of sudangrass and/or other crops to these bacteria under low desert conditions has not yet been documented by land grant university research.

PIVOT BIO PROVEN40 PIVOT BIO PROVEN

PIVOT BIO RETURN

FOLIAR/NON-SOIL N FIXING BACTERIA

There are now several products that are commercially available in which the bacterial species differs from the previously discussed species as to the plant part (foliage) it infects. Instead of being in the soil and/or on plant roots. One advantage of these products is that they can be applied to foliage after plants have emerged, rather than being restricted to pre-plant or at-planting applications.

Gluconacetobacter diazotrophicus

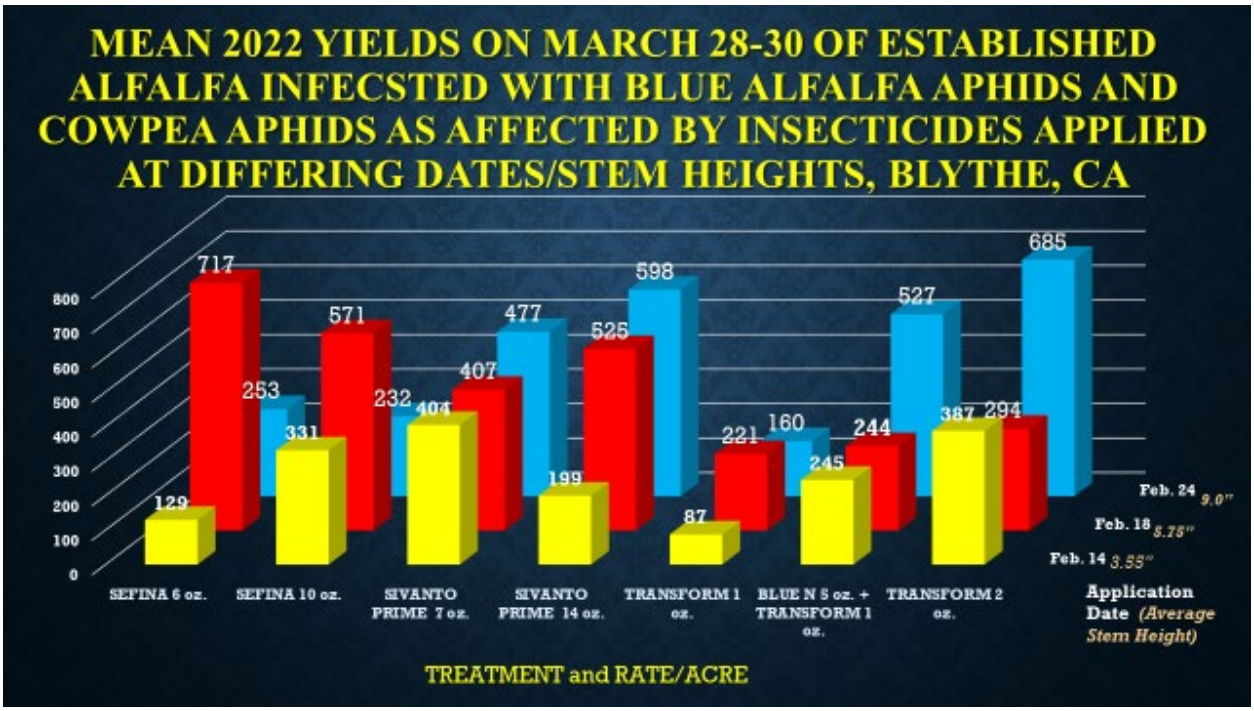
Envita™ (Azotic NA) contains the naturally occurring, food grade bacteria *Gluconacetobacter diazotrophicus*, a species that was originally discovered in sugarcane. Product literature for Envita™ notes that this bacterial species "forms a symbiotic relationship with the host plant and provides nitrogen to cells throughout the plant, both above and below ground, all season long". Envita™ can be applied in-furrow and/or to foliage.

A North Dakoka State University report abstract noted that this tropical bacteria is known to fix up to 150 lbs. of nitrogen/acre in sugar cane (Yuja, 2023). Amounts produced under low desert conditions and for crops with different growing season lengths have not been researched. Local UCCE research with this product in the Palo Verde Valley was initiated on bermudagrass hay, but storms/winds moved windrows and reliable hay yields were not obtained.

Methylobacterium symbioticum

Another species of commercially available bacteria which fixes nitrogen in leaves is *Methylobacterium symbioticum*. This bacterial species differs from the previously discussed species in the part of the plant it infects. Instead of being both in the soil and/or on plant roots, *Methylobacterium symbioticum* provides ammonical nitrogen through the leaves via infection through their stomates. Products that contain *Methylobacterium symbioticum* include Blue N and Utrisha N (Corteva Agrisciences). The latter product has a certified organic label (OMRI).

There are some low desert data for plant response to application of *Methylobacterium symbioticum.* An alfalfa trial in 2022 evaluated application of 1 oz./acre of the insecticide Transform to alfalfa with and without Blue N. Increases in alfalfa yield associated with addition of *M. symbioticum* (as Blue N) were noted to range from 19-367 lbs. of alfalfa hay/acre in just a single cutting, and also averaged 5-6 points higher in relative feed value (RFV) in this experiment when both cowpea and blue alfalfa aphids were present. Yields and quality for subsequent yields were not obtained.



Utrisha-N is being evaluated on other low desert crops. Final cotton lint yield and quality data from a local 2023 field trial with Utrisha-N are not yet available. Mixed results have been noted from local experimentation with usage of Utrisha-N on garlic and bermudagrass (applied to stubble) when just evaluating the plant responses as leaf nitrogen levels. This may be partially due to the upright leaf orientation and potential lack of thorough coverage (one experiment was applied via aerial application).

CONCERNS REGARDING TYPICAL AREA PRODUCTION PRACTICES

Bacteria do very well in moist conditions, but arid low desert conditions may be challenging for the foliar applied bacteria products, especially during late spring-autumn, as the spray may dry before adequate infections of plants via leaf stomates occurs.

Another concern which is yet to be evaluated is the effect of glyphosate on bacteria in plants. It targets the key enzyme of the shikimate pathway (5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), which synthesizes three essential aromatic amino acids (phenylalanine, tyrosine, and tryptophan) in plants. The shikimate pathway is also found in many prokaryotes and fungi.

This latter aspect also needs to be considered when using bacterial based products. Research with RoundUp Power Max in Nebraska for controlling alfalfa rust in RoundUp Ready alfalfa noted activity for almost 35 days after a top of label (44 oz./acre) application (Rethwisch and Willet, 2016a, 2016b), thus a glyphosate application shortly after and prior to a bacterial based product like *Methylobacterium symbioticum* may affect the bacterial levels and activity.

It should be noted that the Nebraska trials occurred in the fall when temperatures were very cool and alfalfa was growing very slowly. The duration of glyphosate activity after an application in low desert RoundUp

Ready crops such as alfalfa and cotton is unknown. Levels of glyphosate in these plants after application would also be expected to be much lower due the rapid growth in warm conditions in the summer.

LITERATURE CITED

Erker, B, and M.A. Brick (with revision by H. Schwartz). 2014. Legume Seed Inoculants – 0.305. Colorado State University Extension publication. 0-305. 2 pp. https://extension.colostate.edu/topic-areas/agriculture/legume-seed-inoculants-0-305.

Jnawali, A.D., R.B. Ojha, and S. Marahatta. 2015. Role of *Azotobacter* in soil fertility and sustainability–a review. *Adv Plants Agric Res*. 2(6):250-253. DOI: 10.15406/apar.2015.02.00069

Kizilkaya, R. 2009. Nitrogen fixation capacity of *Azotobacter* spp. strains isolated from soils in different ecosystems and relationship between them and the microbiological properties of soils. *J Environ Biol*. 30(1):73–82.

Rethwisch. M.D. and S.T. Willet. 2016a. Comparison of Headline EC and RoundUp PowerMax as preventative controls of alfalfa rust, 2013. Plant Disease Management Reports. Vol. 10 (2016): CF001

Rethwisch. M.D. and S.T. Willet. 2016b. Comparison of Headline EC and RoundUp PowerMax as curative controls of alfalfa rust, 2013. Plant Disease Management Reports. Vol. 10 (2016): CF002.

Marella Saritha, and N.V.K.V. Prasad Tollamadugu. 2019. The Status of Research and Application of Biofertilizers and Biopesticides: Global Scenario. Pages 195-207. In Recent Developments in Applied Microbiology and Biochemistry. V. Buddolla, ed. Academic Press. https://www.sciencedirect.com/science/article/pii/B9780128163283000155

Schnitkey, G., N. Paulson, C. Zulauf, K. Swanson, J. Colussi and J. Baltz. "Nitrogen Fertilizer Prices and Supply in Light of the Ukraine-Russia Conflict." *farmdoc daily* (12):45, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, April 5, 2022. Permalink

Yuja, S. 2023. Nitrogen-fixing organisms for sale? North Dakota State University Impact Stories. Jan 22, 2023. https://www.ndsu.edu/agriculture/ag-hub/impact-stories/nitrogen-fixing-organisms-sale

If April Showers Bring May Flowers, Winter Rains Can Trigger Alfalfa Diseases

Michael D. Rethwisch

One of the benefits of growing alfalfa in the low desert is that the usually dry conditions mitigate many diseases from being widespread and severely damaging. Another aspect of the dry conditions is that we tend to not keep alfalfa disease control knowledge and information at the forefront of alfalfa pest management thoughts as there are insect pests that can cause substantial yield loss each and every year.

Last winter (2023) saw many parts of the low desert receive adequate amounts of rain, and winter 2024 is now in the midst of several consecutive rainfall events. This moisture is very conducive to outbreaks of alfalfa diseases in the winter, especially with the dews noted in the mornings resulting in long periods of wet leaves combined with high density crop canopies that further inhibit rapid drying of leaf surfaces.

As January gave way to February there are already several diseases being noted in desert alfalfa before the additional rainfall in February providing extended optimum conditions for disease initiation and growth.

It also provided an opportunity for a replicated fungicide trial here in the Palo Verde Valley with Priaxor Xemium, with an early single application made just prior to the January 20-22 moisture events, a single later application (two weeks later – February 3), and some alfalfa receiving both applications.

This trial is still on-going, and will be for several more weeks, and will allow data to be collected on disease control, yields and alfalfa quality. Examination of alfalfa plants are finding predominantly Stemphylium leaf spot and spring stem, and to a lesser extent some common leaf spot.

Stemphylium leaf spot *(Stemphylium botryosum)*

Stemphylium leaf spot is a cool-season foliar disease. Cool temperatures (60–70°F) and moist weather favor infection and spread. Stemphylium leaf spot on alfalfa is fairly distinctive and unique, as diseased areas are tan with an oval light brown/tan lesion with dark brown/black border (Fig.1), which may often be surrounded by a light yellow halo.

There are different strains of the disease. Strains associated with warmer temperatures continuing to expand beyond the original infection, affecting large portions of leaves. The lesions may expand and form concentric rings (Fig. 2).

Current infections in local alfalfa that initiate near the leaf edges are resulting in a browning/drying of alfalfa tissue with a darker edge around the dried foliage, and yellowing of adjacent alfalfa tissue (Figs. 3-4). As the disease continues to enlarge and desicates infected areas, it often results in several dark lines and/or a target appearance.

Figure 1. Alfalfa leaflet with both Stemphylium (brown area in center, concentric areas can be noted within the discolored areas) and alfalfa mosaic virus (longer yellowed areas).

Figure 2. Alfalfa leaflet infected with *Stemphylium* showing concentric dark bands associated with disease growth and enlargement, surrounded with yellowed newly infected foliage. An area with dark spores is evident near leaflet tip.

Figures 3-4. Stemphylium leaf spot infections that initiate near leaf edges can result in foliar loss between infection and leaflet edge, with expected later continued disease expansion in the leaflet.

Lepto Leaf Spot (*Leptosphaerulina briosiana*)

Stemphyllium leaf spot (not shown) is not the only alfalfa disease in the United States that has a brown/tan center, as *Leptosphaerulina* (Lepto) leaf spot also has brown/tan lesion centers. Lepto leaf spot was not noted as a California alfalfa disease of concern in the 2008 publication Alfalfa Disease and Management section of the 2008 publication "Irrigated Alfalfa Management for Mediterranean and Desert Zones" (University of California Division of Agriculture and Natural Resources Publication 8296). Disease spores, like insects, can be dispersed by winds across wide areas of the globe so growers and PCAs should still be aware of this disease as it is problematic in other parts of the U.S.

In alfalfa, young leaves are most prone to Lepto leaf spot. Symptoms will often start as small, black spots and may remain as a "pepper spots" or they may enlarge to form an "eyespot." The larger eyespots may be oval to elliptical with light brown to tan centers and darker brown borders. A halo might also form around the lesion that can lead to loss of leaflets and possible stunting of stems.

Spring black stem and leaf spot (*Phoma medicaginis*)

Spring black stem is a cool-season foliar disease. Symptoms include small, black-to-dark brown spots on the lower leaves, petioles, and stems (Fig. 5). The lesions are irregularly to triangularly shaped.

As they increase in size, lesions coalesce and become light brown, with affected leaves turning yellow (Fig. 6) and often withering before falling from the plant. Lesions on stems and petioles can enlarge, causing large areas near the base of the plant to turn black. Young shoots are often girdled and killed (Fig. 7). Most damage occurs before the first cutting.

The fungus produces brown-to-black fruiting bodies (pycnidia) on overwintered stem and leaf lesions. Spores released from pycnidia on dead stems during wet weather, spread when rains splash onto foliage and stems. New shoots are infected while growing through crop residue or stubble.

Figure 5. Lesions of spring black stem and leaf spot are irregularly shaped.

Figure 6. Yellowing of alfalfa leaflets associated with infection of spring black stem and leaf spot.

Figure 7. Alfalfa stems infected with spring black stem and leaf spot. Many leaves have dessicated and dropped from stems, reducing alfalfa quality.

Common Leaf Spot (*Pseudopeziza medicaginis*)

Common leaf spot does not kill plants, but the defoliation it can cause can reduce vigor, hay quality, and yield. Symptoms of common leaf spot include small (1/8 in. diameter), circular, brown to black spots on the upper surface of leaves. Margins of spots are characteristically toothed or uneven (Fig. 8). As the disease progresses, infected leaves turn yellow and drop.

In cool, moist weather, the fungus produces circular, raised, brown fruiting bodies, called "apothecia," within the spots. Leaf spot severity increases as the plant continues growing. In California, common leaf spot can cause more leaf loss during curing, raking, and baling than noted before cutting. The leaf loss reduces alfalfa quality.

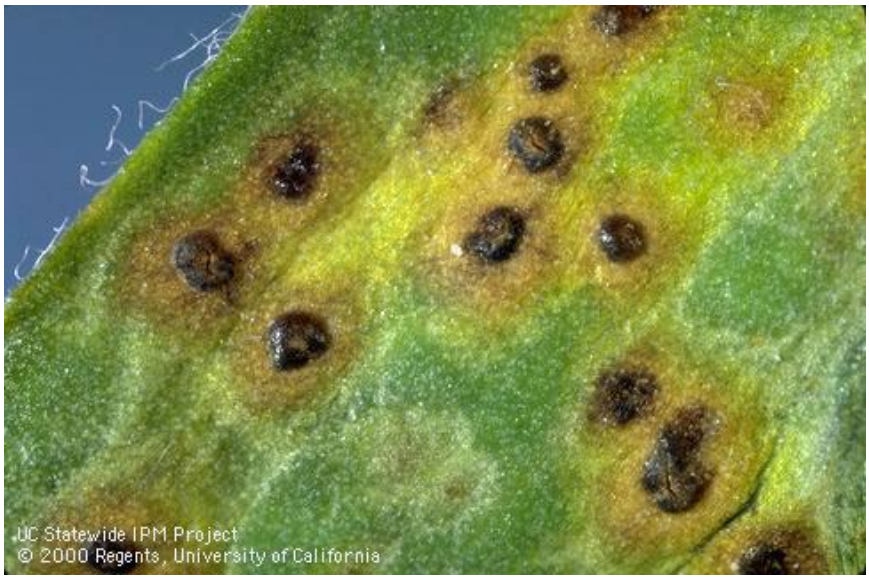


Figure 8. Common leaf spot on alfalfa with mature raised dark fruiting bodies within disease areas. Two younger infections with 'toothed' edges are in lower center.

COMPARISON OF FOLIAR APPLIED BIOSTIMULANTS AND OTHER PRODUCTS ON DEHYDRATOR ONION YIELDS IN THE PALO VERDE VALLEY

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Dehydrator (sometime referenced as processing) onions are a crop that continues to be an important aspect of production agriculture in the Palo Verde Valley and for Riverside County. During 2021-2022 about 4,500 (± 500) acres were harvested annually, with average yields of 18 tons/acre in 2021 and 21 tons/acre in 2022, with annual values over $11 million (2022 Riverside County Ag Commissioner's Report). Locally we have seen much higher yields in some fields (over 25 tons/acre), with the better yields often noted from fields with sandier soils which provide more air space for onion enlargement.

As the potential for higher onion yields does exist, multiple experiments were conducted evaluating various biostimulant products, rates and timings relative to onion growth stage to determine if there are consistent benefits from products to benefit local dehydrator onion production. Some of the products were initially applied at planting and/or at emergence, while another set of products was applied beginning at 3rd green leaf, which is the growth stage fields are now approaching/have reached.

The local experimentation with foliar applied products over several year allowed both a range of products and rates to be evaluated, as well as confidence in the consistency of results when some products were tested more than one year.

RESULTS FROM 2019

CytoPower was applied in large replicated commercial strips across a field, being applied three times (3, 5 and 7 green leaves) at 2 rates (0.55 and 1.1 lbs. product/acre). The higher rate also was evaluated with and without 1 quart/acre of Keylamax Zinc.

Mean yield was increased by each treatment by a minimum of 2.0 tons/acre (Fig. 1) in this field which had a fine sandy loam soil type. Highest yields were noted from the 1.1 lb./acre rate.

When percentages of dissolved solids were examined, there was an inverse relationship for yields and dissolved solid percentages. Highest mean percentage (28.0%) was noted from untreated onions and lower percentages noted from treated onions, with the highest yielding treatment having the lowest (25.74%) percentage (Fig. 2).

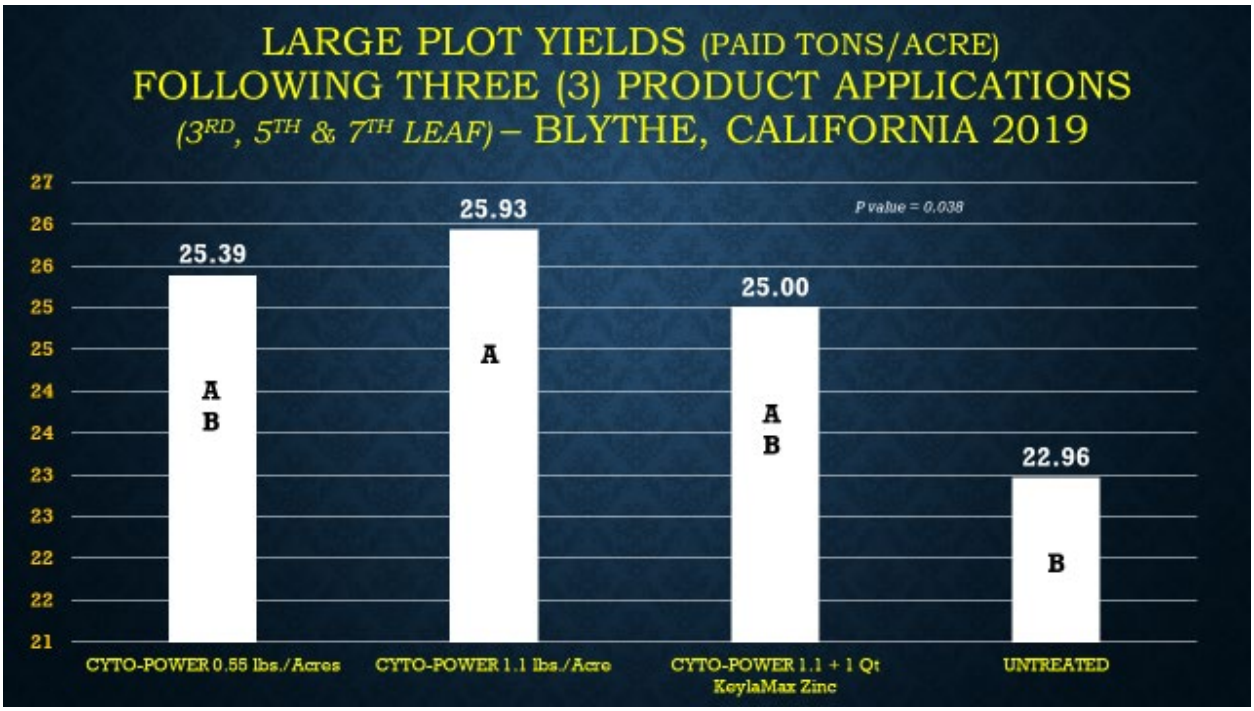


Figure 1. Mean yields of processing onions following 3 applications of CytoPower, Ripley, CA, 2019.

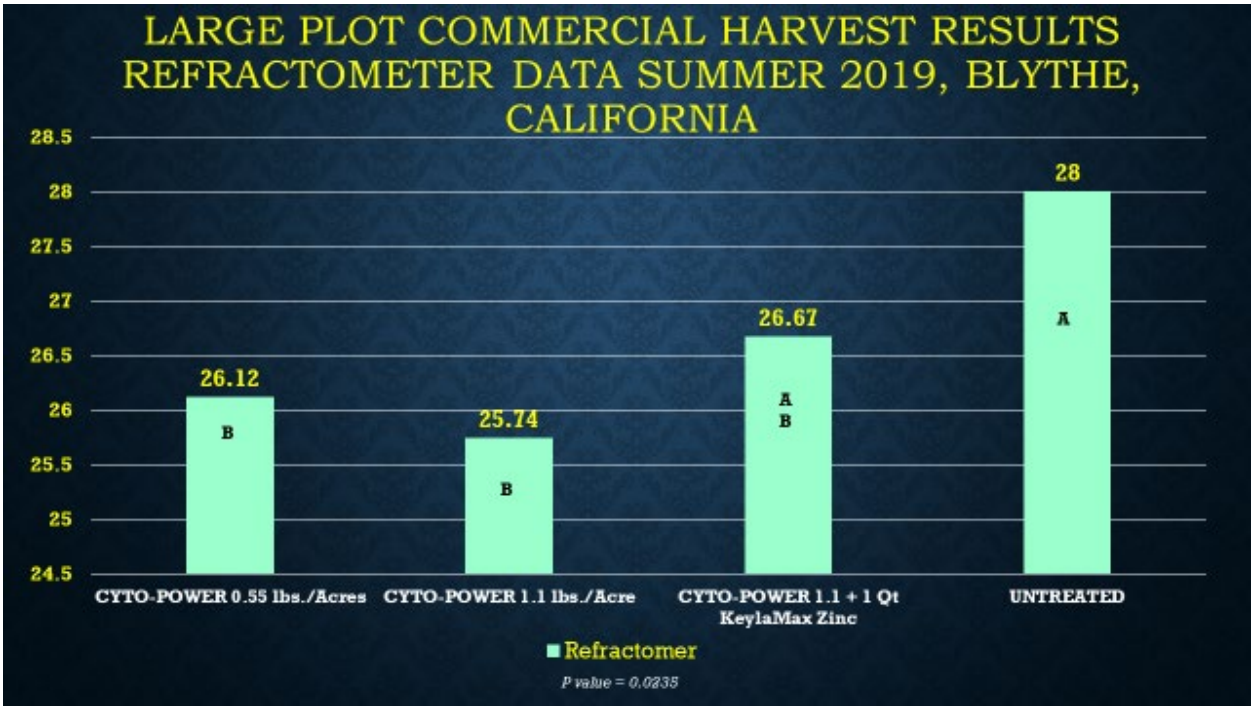


Fig. 2. Mean percentage of dissolved solids of dehydrator onions treated with CytoPower in 2019, Ripley, California.

2020 TESTING AND RESULTS

Testing in 2020 was conducted in a field with silty clay loam soil. Production was challenged during the growing season which was wet and necessitated fungicide applications, and also had some weed control challenges.

This trial evaluated more products, and also compared rates and product application of one product at different growth stages. Treatments and onion size (as green leaves) were as follows:

Product and rate per acre		Development stage (# green leaves)/month when applied		
		3 *(February)*	**5** *(March)*	**7** *(April)*
Action	**8 oz.**	**X**	**X**	
Advantagro	**6 oz.**	**X**	**X**	**X**
CytoPower **+ MultiMax** **+ Keylamax Zinc**	**1 lb.** **32 oz.** **32 oz.**	**X**	**X**	**X**
RyzUp SmartGrass	**0.30 oz.**	**(2 green leaves - Jan. 19)**		
Transit Foliar				
Vitazyme	**20 oz.**	**X**		
Vitazyme	**13 oz.**	**X**		
Vitazyme	**13 oz.**	**X**	**X**	

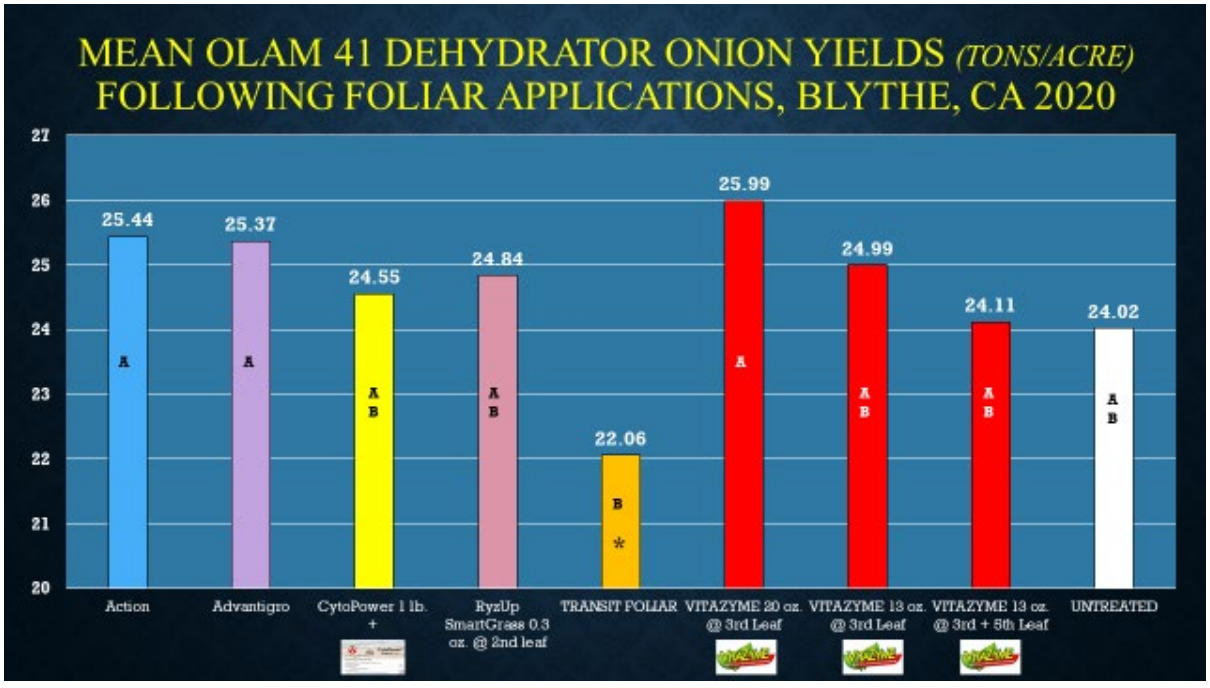


Figure 3. Mean yield (tons/acre) of Olam 41 onions following foliar applications of various biostimulant products during the 2020 growing season

Most treatments resulted in numerically higher yield levels when compared with untreated onions (Fig. 3). Highest yields (25.99 tons) were noted from plots treated with a single application of 20 oz./acre of Vitazyme (Vital Earth) at 3 green leaves, yielding almost 2 tons/acre more than untreated onions. Onion yields in this experiment also exhibited a rate response to Vitazyme, with 20 oz./acre treatment resulting in a ton/acre more yield than the single application of 13 oz. Two applications 13 oz. of Vitazyme did not yield as well as a single application (Fig. 3).

Application of Transit Foliar was detrimental to onion yields in this trial, with all other treatments resulting in a minimum of 0.5 tons/acre more onions than untreated onions (Fig. 3).

2021 Trials

Field experimentation in 2021 involved a Sensient variety of dehydrator onions, and was conducted in a field with silty clay soil. Testing utilized 6 replicates for treatments, and compared two (2) vs. three (3) applications of several products, as the 2020 data had indicated a potential yield reduction for several products when applied at different stages of onion development. Foliar treatments in 2021 were:

Product and rate per acre		Development stage (# green leaves)/date when applied		
		3 *(February 27)*	**5** *(March 19)*	**7** *(April 14)*
Action	**6 oz.**	**X**	**X**	
Advantagro	**6 oz.**	**X**	**X**	
Advantagro	**6 oz.**	**X**	**X**	**X**
CytoPower + MultiMin + K-Amino	**1 lb. 32 oz. 1 lb**	**X**	**X**	
CytoPower + MultiMin + K-Amino	**1 lb. 32 oz. 1 lb.**	**X**	**X**	**X**
FurstClass Concentrate	**16 oz.**		**X**	**X**
GreenSol 48	**8 oz.**	**X**	**X**	
GreenSol 48	**8 oz.**	**X**	**X**	**X**
RyzUp SmartGrass	**0.5 oz**	**X**		
Transit Foliar	**10 oz.**	**X**		**8 leaf** ***(April 20)***
Vitazyme	**10 oz.**	**X**		
Vitazyme	**20 oz.**	**X**		
Vitazyme	**30 oz.**	**X**		
Vitazyme	**10 oz.**			**X**
Vitazyme	**20 oz.**			**X**
Vitazyme	**30 oz.**			**X**
Vitazyme	**13 oz.**	**X**		
Vitazyme	**13 oz.**	**X**	**X**	
Vitazyme	**13 oz.**	**X**	**X**	**X**

2021 Results

Highest yields in 2021 were noted from the treatment consisting of two (2) applications of CytoPower plus 1 qt./acre of MultiMin and 1 lb./acre of K-Amino which resulted in 18.71 tons/acre, 1.86 tons/acre more than untreated onions (Table 3). This was followed by 20 oz./acre of Vitazyme applied the 3 green leaf stage, at 7 green leaves and the 10 oz./acre rate of Vitazyme at 7 applied at 7 green leaves. Overall, 12 of the treatments resulted in a minimum increase of 0.5 tons/acre.

A few treatments were noted as resulting in yields basically equal to or reduced when compared with untreated onions. Treatments being almost the same included 0.5 oz./acre of RyzUp SmartGrass at 3 green leaves, Vitazyme at 10 oz./acre at 3 green leaves, and 10 oz./acre of Transit Foliar applied at 3 and 8 green leaves. Three applications of GreenSol 48 (FRIT Industries) reduced yields by 0.48 tons/acre (Table 3).

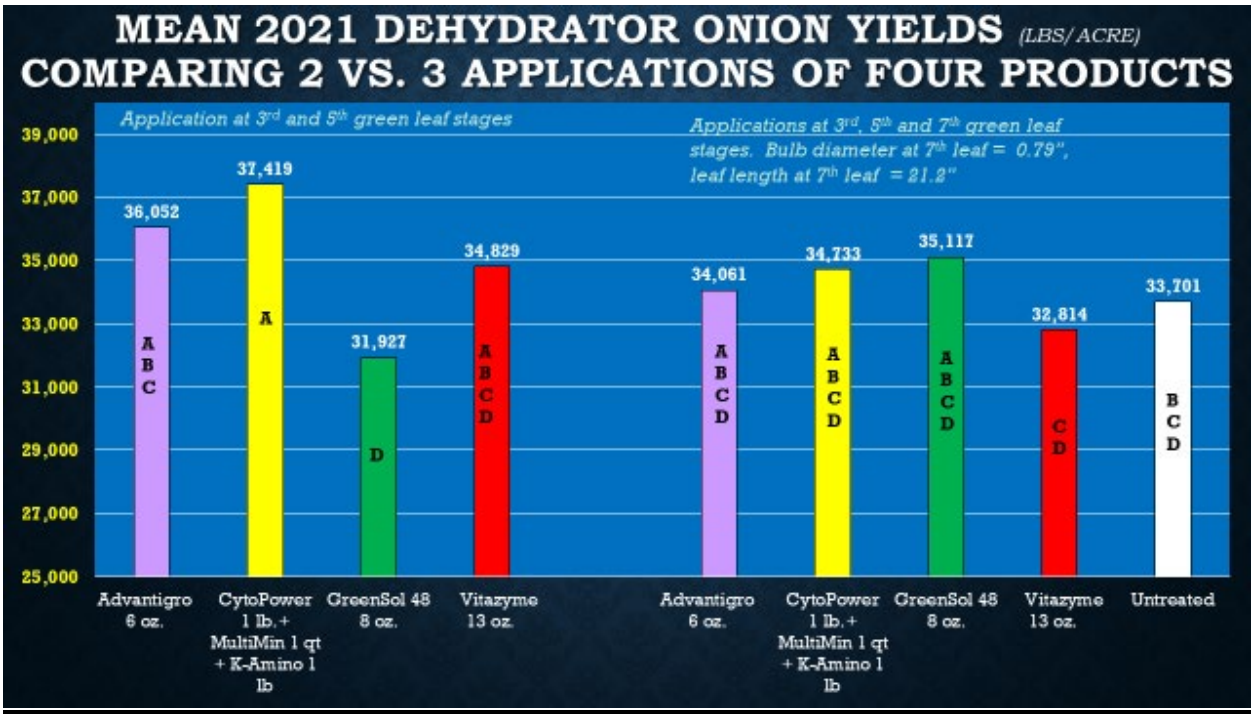
Table 3. Mean 2021 dehydrator onion yields (tons/acre) following foliar applications of various biostimulant products at various growth stages in the Palo Verde Valley.

Yield rank	Product and Rate/acre		Onion Stage *(Green Leaves)* when Applied	Mean Yield (Tons/acre)	Difference vs. untreated onions (tons/acre)
1	CytoPower + MultiMin + K-Amino	1 lb. 32 oz. 1 lb.	3, 5	18.71	1.86
2	Vitazyme	20 oz.	3	18.37	1.52
3	Vitazyme	20 oz.	7	18.33	1.48
4	Vitazyme	10 oz.	7	18.31	1.46
5	FurstClass Concentrate	16 oz.	5, 7	18.12	1.27
6	Advantigro	6 oz.	3. 5	18.03	1.18
7	Action	6 oz.	3, 5, 7	17.92	1.07
8	Vitazyme	30 oz.	7	17.68	0.83
9	GreenSol 48	8 oz.	3, 5, 7	17.56	0.71
10	Advantigro	6 oz.	3, 5, 7	17.50	0.65
11	Vitazyme	13 oz.	3, 5	17.41	0.56
12	CytoPower + MultiMin + K-Amino	1 lb. 32 oz. 1 lb.	3, 5, 7	17.37	0.52
13	Vitazyme	30 oz.	3	17.05	0.20
14	Vitazyme	13 oz.	3	17.04	0.19
15	RyzUp SmartGrass	0.5 oz.	3	16.87	0.02
16	Vitazyme	10 oz.	3	16.86	0.01
17	Untreated			16.85	0.00
18	Transit Foliar	10 oz.	3, 8	16.81	-0.04
19	Vitazyme	13 oz.	3, 5, 7	16.41	-0.44
20	GreenSol 48	8 oz.	3, 5	15.96	-0.89

When comparing 2 vs. 3 applications of products, most were more effective with just 2 applications, with lower yields noted with the additional 3rd treatment applied at the 7 green leaf stage. This was not true for all treatments, as onion yields with three applications of GreenSol 48 resulted in 1.6 tons/acre more than applications at just 3 and 5 green leaves. This indicates onions are highly responsive to the fertilizer combined with gibberellic acid + cytokinin in GreenSol 48 at the 7 leaf stage.

Additional testing is needed to verify that a single application of GreenSol 48 at the 7 green leaf stage of dehydrator onion will provide a similar yield increase (0.71 more tons/acre than untreated onions).

The yield increase may be even greater in light of the reduction noted (-0.89 tons/acre) when associated with the applications of this product at 3 and 5 leaves. This indicates a 1.60 tons/acre increase may have occurred for the application at 7 green leaves.



Consistency of results over multiple years

One of the main concerns growers have with new products is the consistency of results. When using percentage of untreated yields for products which had the same rates and application timings both years, a pattern was noted, indicating high confidence in results. Three products provided highest average yields over 2020-2021, with greatest from a single 20 oz./acre of Vitazyme applied at the 3 green leaf stage (108.6% of untreated). This was followed by the 2 applications treatment of CytoPower + MultiMin + KeylaMax Zinc/K-Amino (106.6%) (Table 4). Advantagro (Wilbur-Ellis Co.) resulted in 106.3% of untreated onions, but this product is not currently registered for usage in California. All other products resulted in yields that were less than 103% of untreated onions.

Table 4. Comparative Percent Yield of Untreated Processing Onions Treated with Biostimulant Products in both 2020-2021.

Treatment and rate/acre	Onion Growth Stage when applied	2020	2021	Average %
Vitazyme 20 oz.	3 Green Leaves	108.2	109.0	108.6
CytoPower 1 lb. + MultiMin 32 oz. +*KeylaMax Zinc 32 oz. *(2020)* + **K-Amino 1 lb. (*2021*)	3 Green Leaves + 5 Green Leaves	102.2	111.0	106.6
Advantigro 6 oz.	3 Green Leaves + 5 Green Leaves	105.6	107.0	106.3
Vitazyme 13 oz.	3 Green Leaves	104.0	101.1	102.6
Vitazyme 13 oz.	3 Green Leaves + 5 Green Leaves	100.4	103.3	101.8
RyzUp SmartGrass 0.3 oz.	2 Green Leaves (2020), 3 green leaves (2021)	103.4	100.1	101.7
Transit Foliar 10 oz./8 oz.	3 Green Leaves + 8 Green Leaves	91.8	99.8	95.8
MEAN UNTREATED YIELD AT SITE *(Tons/acre)*		24.02	16.85	

*KeylanMax Zinc used in 2020, no K-Amino used this year; **K-Amino used in 2021 at rate of 1 lb./acre, No KeylaMax Zinc

A big "Thank You" to the many growers and industry folks in the Palo Verde Valley for access to fields and other assistance in projects during 2023!! This is greatly appreciated!

CHAFFIN RANCHES …..……...Evaluation of Sosdia Stress/Utrisha-N on Cotton, Cotton Fruit Losses

COXCO FARMS……Evaluation of Siapton in Late Spring Alfalfa

ENH FARMS…….…….…… Daily Cotton Fruit Losses

FISHER RANCHES ……Product Evaluation to Reduce Brown Bead in Broccoli

FONDOMONTE…….……...Alfalfa response to various biostimulant products applied via Swather

HELENA AGRI-ENTERPRISES ….....Providing CoRoN 10-0-10-0.5B, and other products for testing

NOROIAN FARMS..... Daily Cotton Fruit Losses; Cotton Response to Siapton, AgStress RX

RIO RANCHO ……...Organic Fertilizers for Garlic, Product Evaluations to Increase Cotton Yields

RIVER VALLEY RANCHES…….…….……..… Daily Cotton Fruit Losses

STANWORTH CROP CONSULTANTS ...……Assistance Obtaining Samples and Chemical Analyses

VAN DYKE FARMS…....Alfalfa Insecticide Efficacy Trials, Envita for Bermuda Grass Hay Production

PCAs - Rich Wellman, Mark Reay…..For their Cooperation and Assistance with many of these Projects!

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