University of California
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Cooperative Extension, Stanislaus County

VEGETABLE VIEWS

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Fusarium Crown Rot in Watermelon

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In late June, I was contacted by a watermelon grower and visited his field near the Stanislaus and Merced County lines. In the field, 50% of the plants showed signs of leaf and vine wilt and about 20% died (see Image 1). After closer examination, the color of leaf lesions was chocolate brown and the stem appeared to be watery (Images 2 and 3). The grower explained that the field was only harvested once, but symptoms were already present beforehand. The field was planted by a 45-ct and mini-watermelon cultivars.

Initial diagnosis was a fusarium disease and/or a possible Gummy Stem Blight caused by *Didymella bryoniae*, though this is very uncommon for watermelon in California. I sent leaf, runner, and stem samples to the UC Davis Fungal Pathogen Lab and the results came back with the Fusarium Crown Rot caused by F. *solani* f. sp. cucurbitae and possibility of F. *falciforme*. F. *falciforme* has not been found to infect watermelon, but research has shown it could cause crown rot in muskmelon. Gummy stem blight (*Didymella bryoniae*) colonies were not recovered from the samples, which was not surprising because this disease is most prevalent in the southeast and northern states, such as Georgia, South/North Carolina, and Delaware.

Unlike fusarium wilt caused by F. *oxysporum* f. sp. niveum, the vascular system of crown rot infected plants typically does not show discoloration far above the soil line. Instead, necrotic rot of crown and taproot can be seen. As the disease progresses, the rot on the crown develops from light-colored, water-soaked lesions into darker necrotic damage. Eventually, the entire plant wilts and dies. Evidence indicates that fusarium crown rot is more common on summer squash and pumpkin, however, all cucurbits can be infected.

Early planted fields may have a higher chance to be infected as disease favors cooler temperatures to develop and spread. Soil moisture does affect development of the disease. Extremely wet soil, especially due to drip tape breakage, creates a favorable microclimate. which accelerates the reproduction of spores and spread of the disease to other rows. Growers using surface drip irrigation should pay more attention to the tape damage and fix the problem promptly.

Various types of information demonstrate that the pathogen (F. *solani* f. sp. cucurbitae) is seed-borne and survives for only two to three years in soil. A four-year rotation of planting non-cucurbit species is usually chosen for disease control. In addition, choosing clean seeds or fungicide-treated seeds can reduce disease initiation. More information about the Fusarium crown rot on cucurbits can be found at UC IPM: http://ipm.ucanr.edu/PMG/r116100911.html.

In This Issue

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1. Vine-decline and wilted watermelon plants from the disease infection.

2. Leaf discoloration and dark chocolate lesions.

3. Water-soaked, necrotic rot of the crown.

Evaluation of Acifluorfen-Containing Herbicide in Basil: Impacts on Yield, Leaf Injury, and Weed Control

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Introduction

Basil is one of the most important herb spices in diets of the Central Valley people. As the major basil production state, California's commercial basil is usually grown without the application of any herbicides after seedling emergence. Most herbicide applications occur at pre-plant or immediately after seeding. However, a very limited number of herbicides are currently registered for use on basil, forcing growers to fight against weed resistance and deploy a tremendous amount of labor for hand removal. Therefore, screening existing herbicides and collecting their performance on weed suppression and plant injury will help support the registration, offering basil growers more choices for chemical weed control and reducing labor cost for manual weeding.

Trial Initiation

The evaluation trial was initiated on the Ratto Bros, Inc. commercial field in Modesto, California (37.690306, -121.093324) to test the efficacy of an Acifluorfen-based herbicide, 'Ultra Blazer', on basil field weed control, leaf injury, and final yield. The field was double-line seeded into 40-inch wide beds with basil varieties: 'Passion', 'Obsession', 'Devotion', and 'Helena' on June 2, 2020. According to the USDA Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm), the field soil type is Dinuba Sandy Loam with 0-1% slope. For each variety, the experiment was implemented as a randomized, complete block design including three herbicide application treatments and two non-treated controls with and without hand weeding (Table 1). Each treatment plot was 5 feet long (double lines of plants = 10 row feet) and replicated 4 times. 'Ultra Blazer' and the grower's standard herbicide, 'Devrinol 50-DF' (50% Napropamide as the active ingredient), were applied immediately after seeding as a soil spray at 55 GPA. All fields were irrigated as needed for crop health and heat stress prevention using the sprinkler system throughout the growing season. Disease and pest control, as well as fertilization, followed the Ranch's standard practice.

According to the product label, Ultra Blazer (20.1% sodium salt of acifluorfen as the active ingredient) is "a selective, post-emergent herbicide for the control of broadleaf weeds and grasses in peanuts, soybeans, strawberries, and rice." It can be applied before or after crop emergence. When applied to soil pre-emergently, the active ingredient is absorbed through roots and leaves of germinating and growing-susceptible weeds. The killing activity is enhanced by sunlight and increased temperature.

Weed and Plant Injury Monitoring

Starting seven days after seeding (DAS), a total area of 8 sq. ft was framed and pictured from each treatment within a block on a weekly basis until seven weeks after seeding (49 DAS). For weed-free plots, hand weeding was deployed right before pictures were taken. These pictures were used to evaluate weed control effects in each treatment over the growth period. Weed control was rated by scales 0-5, where 0 = no visible weeds or all visible weeds were dead in the frame area, 1 = visible weeds no more than 10% of the frame area, 2 = visible weeds between 10% and 25%, 3 = visible weeds between 25% and 50%, 4 = visible weeds between 50% and 75%, and 5 = visible weeds over 75%. A pictorial example showing different ratings is included (Figure 1). After emergence, leaf injury was monitored weekly (picture day) based on visual assessment of herbicide damage symptoms, such as leaf stunting, chlorosis, necrosis, cupping, or curling.

Basil Growth Evaluation
Basil leaf Normalized Difference Vegetative Index (NDVI) was scanned at 30 inches above canopy using a GreenSeeker Crop Sensor on 21, 28, 35, and 49 DAS, respectively. The measurements gave us general assessments and comparisons of canopy coverage and growth inhibition caused by herbicide damage. On 35 and 49 DAS, leaf chlorophyll concentration was measured using an MC-100 Chlorophyll Concentration Meter. Three randomly picked intact leaves from different plants within a plot were non-destructively measured for chlorophyll concentration. Two spots per leaf, symmetric to the center vein, were scanned and a total of six readings were averaged for each treatment plot. The chlorophyll concentration was reported as µmol.m-2.

Harvest
The trial was hand-harvested on August 4, 2020. For each treatment, basil plants were harvested from the double 5-ft lines by cutting the stems at 4 inches above the soil and placed immediately in a zip lock bag. All bags were weighed for the total fresh biomass (lbs./plot) in the field using a digital scale.

Data Analysis
All data were subjected to the ANOVA (analysis of variance) in SAS 9.4 to determine the existence of a difference. Mean comparisons were made using Fisher's Protected LSD at $\alpha = 0.05$. Fresh weight was compared among herbicide treatments and non-treated controls for each basil variety. NDVI and chlorophyll concentration were plotted individually by basil variety and compared among treatments for each measuring date.

Results
Daily high and low air temperature. According to the data from The UC IPM California Weather Data (http://ipm.ucanr.edu/WEATHER/wxactstnames.html#), the average daily high and low temperature in Modesto during the trial (June 2 – August 3) was 92.4 and 55.5 ºF (Figure 2). The precipitation during the trial period was zero.

Leaf injury and weed control. From this study, no substantial leaf injury was observed, indicating that the four basil varieties included in the trial are potentially non-susceptible to the acifluorfen. No weed ratings from week one (7 DAS) to week five (35 DAS) were greater than scale 1 for each basil variety treated by both herbicides except for variety 'Passion' treated with Ultra Blazer at 1.5 pt./acre on 35 DAS (Table 2). However, the control effect was varied among grasses, sedge, and other broadleaf weeds for both application rates of Ultra Blazer. After two weeks of application, stunting and lesions appeared on sedge (Figure 4) and grass leaves (picture not included) followed by leaf discoloration and plant death. Overall, broadleaf weeds such as Portulaca oleracea and Malva neglecta, which are the common species in the field, were less effectively controlled causing some coverage later in the season. For some treatment plots, the common purslane took over 50% of the frame area (Figure 5).

Plant growth. As there was minor to no leaf injury detected, leaf chlorophyll concentration was not impacted by the application of herbicides (Figure 6). For NDVI, there was no difference among treatments at 21 DAS. However, as the season progressed, the highest NDVI was measured for non-treated weedy plots at 35 DAS (Figure 7). The highest NDVI was attributed to the large coverage of weeds. At 35 DAS, soil area between two seeding lines was still not closed for all herbicide and weed-free treatments compared to the situation in non-treated weedy plots (Figure 3).

Leaf fresh biomass. Overall, plots applied with both herbicides at all rates produced statistically the same yield as the weed-free treatment for all basil varieties (Table 3). However, it is worth noting that fresh biomass from plots treated with Ultra Blazer at both rates did not differ from yields of non-treated weedy plots for each basil variety, with the exception of variety 'Helena' applied at 1.5 pt./acre (Table 3); whereas, three out of four basil varieties produced higher biomass when applied with grower's standard Devrinol 50-DF than the non-treated weedy plots (Table 3).

Conclusion
From this trial, the efficacy of the acifluorfen herbicide applied at each rate performed positively on weed control and leaf injury, although broadleaf weeds were not equally controlled for some basil varieties at 1.5 pt./acre rate. To improve the broadleaf weed control, such as

…Evaluation of Acifluorfen-Containing Herbicide continued

purslane, which is on the label, using a higher than 1.5 pt./acre rate and applying post-emergently may be possible. According to the Ultra Blazer label, 1.5 pt./acre is the only effective, and maybe the minimal, rate on the control of common purslane and can be applied up to the canopy stage of 6” diameter and 1” height in peanut and soybean fields. Applying right after purslane emergence may enhance the control effect through a quicker compound absorption via rapid-growing roots and expanding leaves.

CAUTION: The herbicides tested in these trials are currently not registered for use on basil. The rates tested in these studies are designed for research purposes only and do not reflect the actual use on your crops. Always follow the herbicide label directions attached to the herbicide container you are using.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.

2020 Vegetable Research Projects: https://youtu.be/FxzoJR0RXlY

Figure 1. Pictorial examples of different weed ratings.

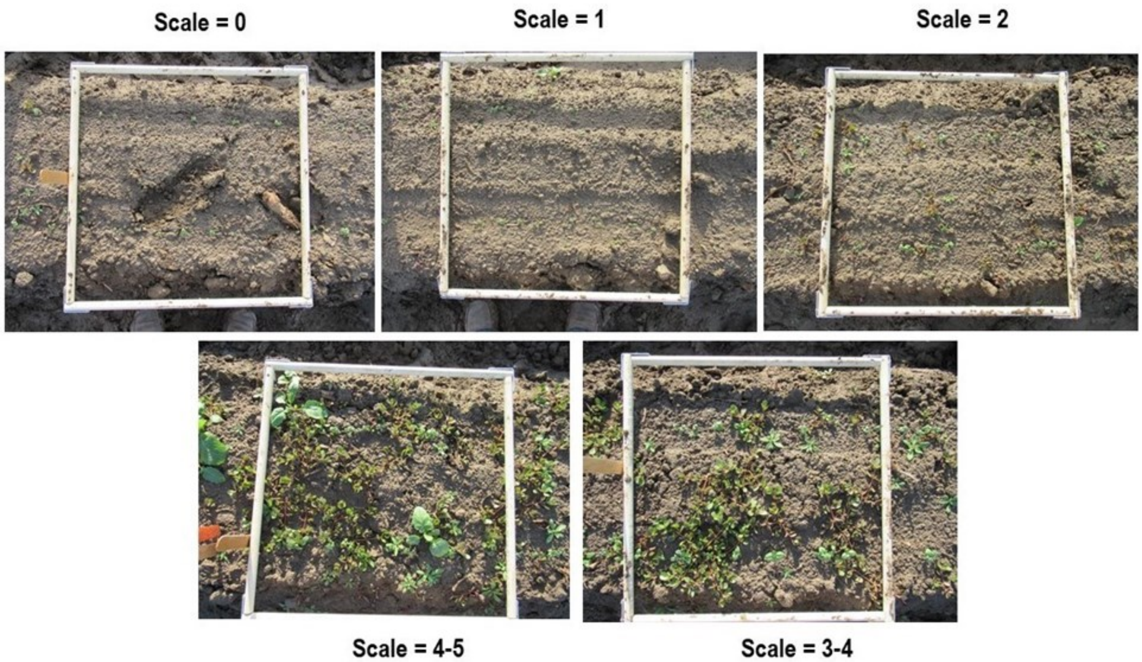
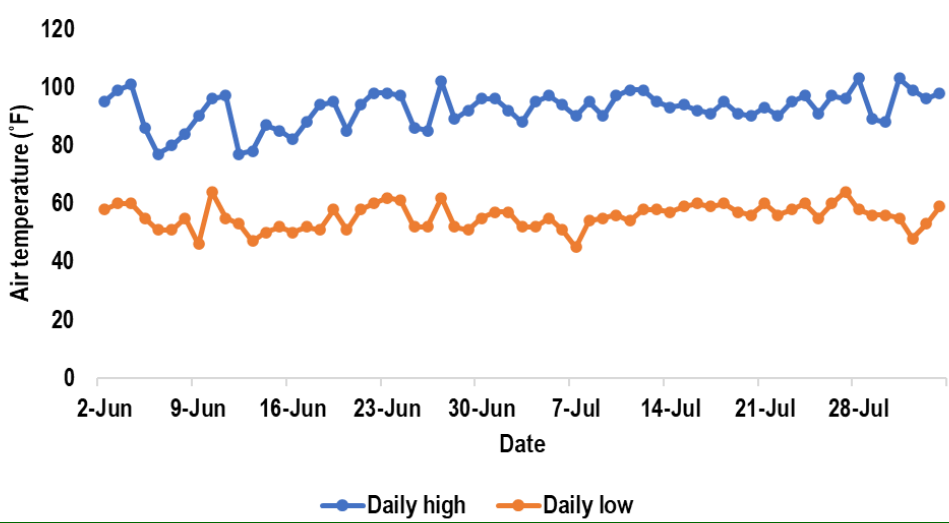


Figure 2. Average daily high and low temperature during the trial in Modesto, California (June 2 to August 3).



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...Evaluation of Acifluorfen-Containing Herbicide continued

Weedy	1.5pt	3.0pt	Standard	Weedfree

Variety = ‘Obsession’

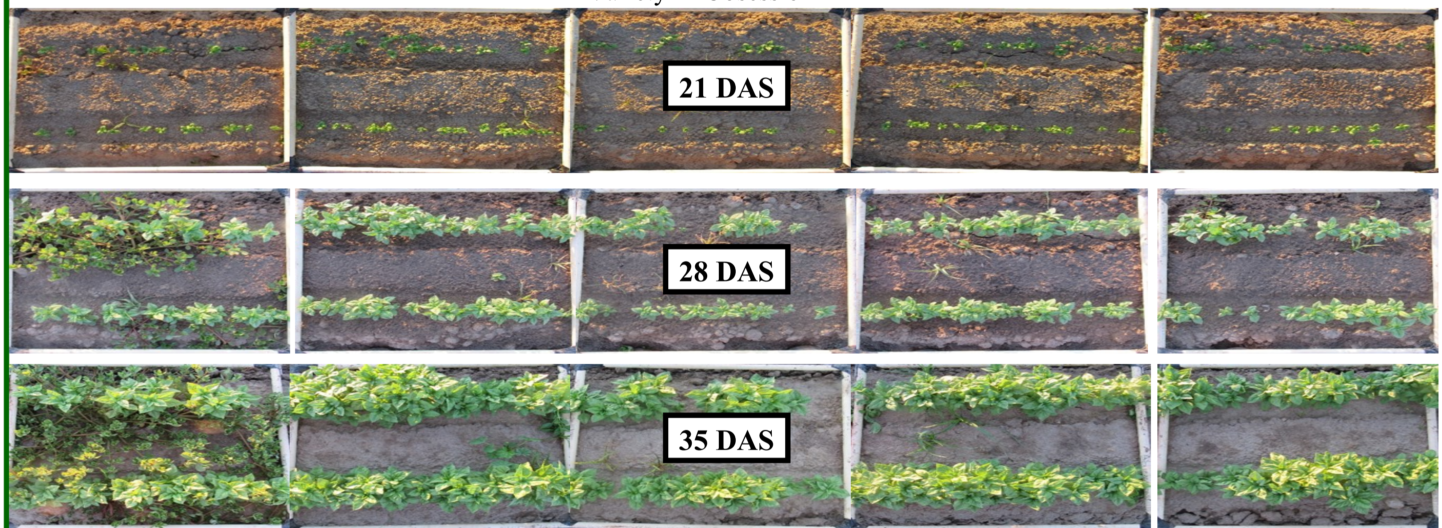

Figure 3. Frame images at three evaluation dates showing the comparisons of basil growth and weed control among treatments.

Figure 4. Close-up images of affected sedge weeds treated by the Ultra Blazer at 1.5 and 3 pt./acre (Pictures were taken at 14 DAS).

Figure 5. Pictures of failure in common purslane control at 1.5 pt./acre on 28 and 35 DAS for variety Passion in comparison to sedge control. Note the lesions on the leaf that is being killed by the acifluorfen.

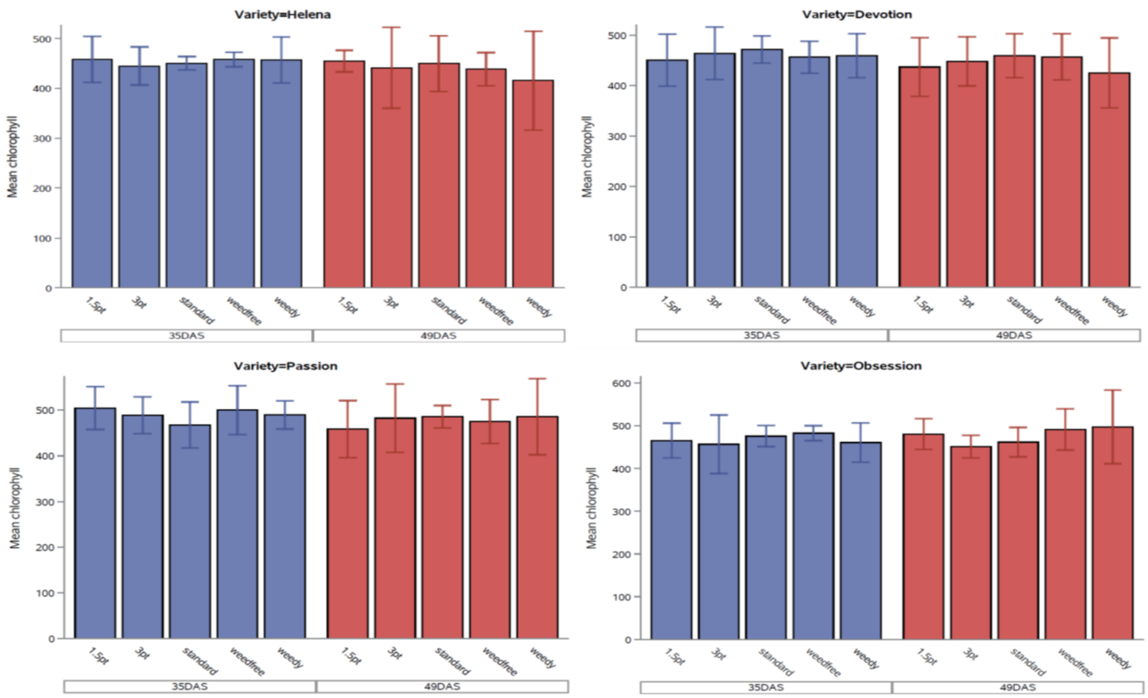

Figure 6. Mean chlorophyll concentration (µmol.m-2) at each measuring date for each basil variety under different herbicide treatments.

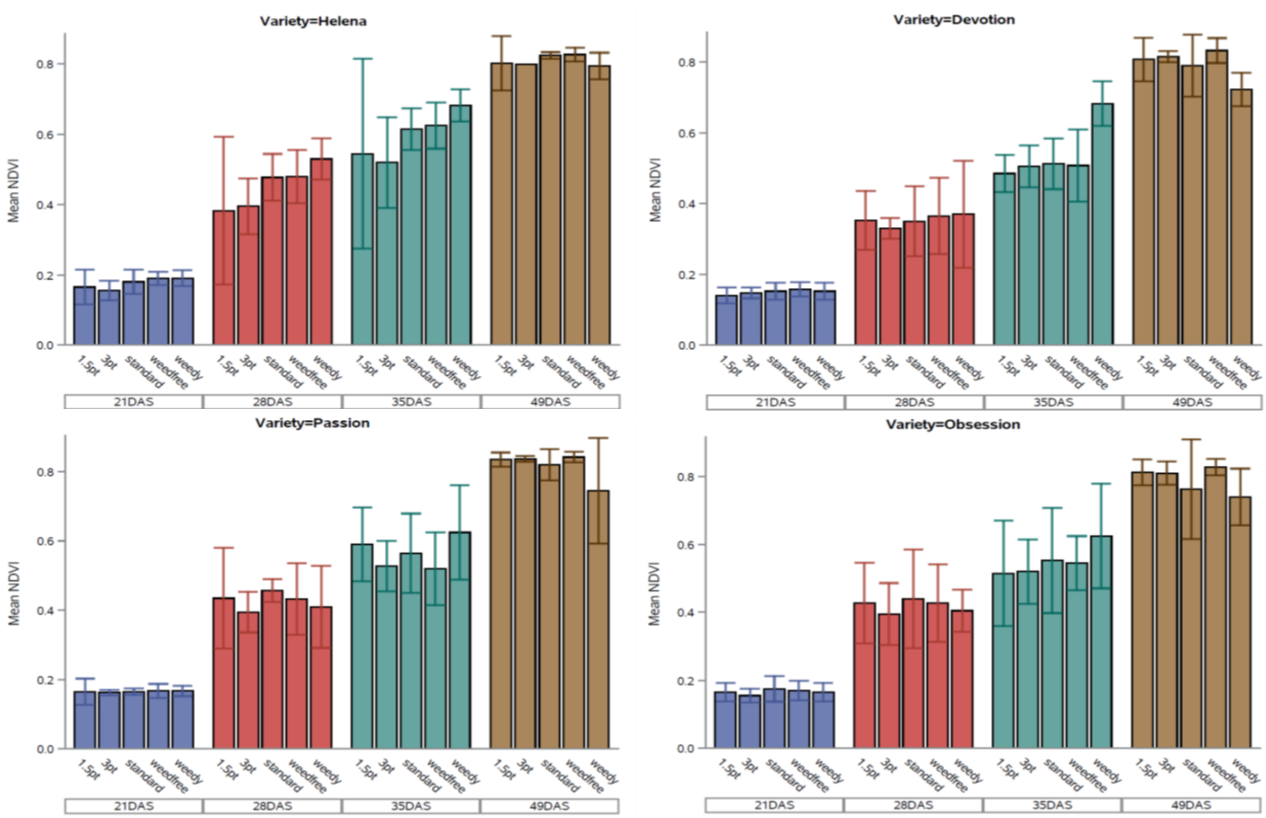

Figure 7. Mean NDVI at each measuring date for each basil variety under different herbicide treatment

Table 1. Herbicide application treatments.

Herbicide trade name	Active ingredient	Rate of products	Rate of active ingredient	Noted in this article
Non-treated weedy	N/A			weedy
Ultra Blazer*	Sodium salt of acifluorfen	1.5 pt./acre	0.375 lb./acre	1.5pt
Ultra Blazer	Sodium salt of acifluorfen	3.0 pt./acre	0.75 lb./acre	3pt
Devrinol 50-DF*	Napropamide	2.5 lbs./acre	1.25 lbs./acre	standard
Non-treated weed free	N/A			weedfree

*The Ultra Blazer and Devrinol 50-DF were soil applied immediately after seeding.

Table 2. Average weed rating for each basil variety.

V= 'Devotion'	7 DAS	14 DAS	21 DAS	28 DAS	35 DAS
Weedy	0.0	0.8	1.0	2.5	4.3
1.5pt	0.0	0.3	0.5	0.8	1.0
3pt	0.0	0.5	0.8	0.5	0.5
Standard	0.3	0.3	0.5	0.8	1.0
V = 'Helena'					
Weedy	0.0	1.0	1.5	2.8	4.5
1.5pt	0.0	0.0	0.0	1.0	0.5
3pt	0.0	1.0	1.0	0.8	0.8
Standard	0.0	0.0	0.0	0.3	0.3
V = 'Obsession'					
Weedy	0.3	1.0	1.5	3.0	4.3
1.5pt	0.0	0.5	0.8	0.8	0.8
3pt	0.0	0.3	0.3	0.8	0.8
Standard	0.0	0.0	0.8	0.8	1.0
V = 'Passion'					
Weedy	0.3	0.8	1.5	2.5	4.3
1.5pt	0.0	0.8	0.5	0.8	1.5
3pt	0.0	0.5	0.3	0.3	0.3
Standard	0.3	0.3	0.8	1.0	0.8

The weed rating for each treatment is based on the average estimation from four blocks on a given date.
Weed-free plots were hand weeded before taking quadratic pictures, and therefore rated as 0 (not listed in the table).

Table 3. Comparisons of the average fresh weight (lbs./plot) for each basil variety.

Treatment	V = 'Devotion'	V = 'Helena'	V = 'Obsession'	V = 'Passion'
weedy	6.53 B	7.41 B	8.17 B	6.90 B
1.5pt	7.60 AB	10.36 A	9.68 AB	8.24 AB
3pt	7.68 AB	8.91 AB	9.30 AB	8.14 AB
standard	8.17 A	8.79 AB	10.60 A	8.93 A
weedfree	7.99 AB	9.75 A	10.77 A	9.56 A
$LSD_{0.05}$	1.59	1.62	2.26	1.93

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Nitrogen Accumulation in Processing Tomato Fields Following Fall-Applied Compost

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Compost amendments can be used to build soil organic matter and promote efficient cycling of plant nutrients. The emergence of financial incentives programs along with the relatively low cost of composts makes them an economically attractive way to build soil health and increase plant -available nutrients. Managing compost according to the "4Rs" (right source, right rate, right time, and right placement) becomes difficult when considering the "right time" of compost application. This is because compost amendments require decomposition following soil incorporation to release nutrients and the timing of nutrient release may or may not correspond to the time of greatest crop demand. Applying compost in the fall following harvest would be the most convenient application time for processing tomato growers in the Central Valley, however, the value of fall-applied compost as a supplemental nitrogen source is still poorly understood. Therefore, two processing tomato trials were established in Patterson, Calif. on a Capay clay soil to evaluate the accumulation of inorganic nitrogen following fall-applied green waste compost. Compost (25% moisture, 2% Total N, and 16:1 (C:N); RecologyOrganics.com) was broadcast-applied on October 30, 2019, at a rate of 5, 10, and 15 tons per acre (T/Ac) in two adjacent fields, Field One-North (F1N) and Field Two-South (F2S), following harvest of processing tomatoes (Photo 1 and 2). Each compost rate and an unamended control (0 T/Ac) were evaluated on individual plots and replicated four times, resulting in 16 plots each in F1N and F2S. Soil samples collected in November 2019 were used to characterize initial soil properties of each field. Beginning in December 2019, an in-field buried bag method was used to monitor inorganic nitrogen accumulation from the amended and unamended plots. Soil was collected from each plot, bagged, and buried back in the plot from which it was removed to a depth of 6 inches. Buried bags were sampled by removing one bag per plot per month and the average inorganic (ammonium + nitrate)-nitrogen availability was measured from December 2019 to March 2020.

Inorganic nitrogen availability exhibited a similar trend among compost treatments one month after application in December 2019 in F1N ranging from 19 to 22 lbs. N/Ac, whereas, in F2S inorganic nitrogen availability of the 15T/Ac compost was noticeably lower (13 lbs. N/Ac) compared to 5 and 10 T/Ac compost which ranged from 27 to 29 lbs. N/Ac (Table 1). Over the next three months (January to March), inorganic nitrogen availability remained similar between 5 and 10T/Ac compost for both F1N and F2S with differences of only 2 to 3 lbs. N/Ac. Whereas, the application of 15T/Ac compost resulted in the lowest inorganic nitrogen availability in January in both F1N and F2S. Despite the lower inorganic nitrogen availability of the 15T/Ac compost in January, there was a relatively large increase in the following two months (February and March). This can be seen most clearly as the percent change between February and March, with inorganic nitrogen availability from 15 T/Ac in March increasing by 74% in F1N and 80% in F2S relative to February. This contrasts with the moderate increase of inorganic nitrogen availability in March from 5T/Ac of 20% (F1N) and 13% (F2S) and from 10T/Ac of 25% (F1N) and 31% (F2S) relative to February. While total inorganic N was on average 27 lbs. N/Ac less from 15T/Ac compared to 5T/Ac and 10T/Ac, the large increase of inorganic nitrogen availability from February to March suggests inorganic nitrogen becomes more available from the highest compost application rate as time increased since soil incorporation in the fall.

Overall, applying green waste compost in the fall resulted in cumulative inorganic nitrogen availability in the spring that was similar or less than the unamended soil. There was a trend of initially low inorganic nitrogen availability with 15T/Ac compost application followed by a large increase, a trend that demonstrates the need to appropriately match compost application timing with expected nutrient availability. These preliminary results are a component of ongoing research and planned measurements for the 2020 growing season include leaf nutrient concentration and fruit yield and quality. These additional measurements will tell a more complete story and help better define the "right time" for compost application in processing tomato fields.

	Field One-North				
Compost (Ton/ Ac)	**Dec19**	**Jan20**	**Feb20**	**Mar20**	**Total**
0	17 ± 3	29 ± 8	19 ± 6	42 ± 3	107
5	19 ± 6	20 ± 6	30 ± 3	36 ± 3	105
10	22 ± 7	23 ± 6	28 ± 7	35 ± 4	108
15	19 ± 9	7 ± 2	19 ± 7	33 ± 6	78
	Field Two-South				
0	23 ± 8	45 ± 8	38 ± 5	62 ± 4	170
5	27 ± 14	24 ± 13	32 ± 7	36 ± 10	120
10	29 ± 9	27 ± 10	29 ± 7	38 ± 2	123
15	13 ± 8	14 ± 7	25 ± 9	45 ± 12	97

Table 1. Average (± standard error) and total inorganic N (lbs. N/A) accumulation from 5, 10, or 15 tons per acre (T/Ac) of green waste compost compared to unamended (0 T/Ac) soil from December 2019 (Dec19) to March 2020 (Mar20) in Field One-North (F1N) and Field Two-South (F2S) processing tomato fields. *project was supported by funding made available through the California Tomato Research Institute under the project, "Influence of Compost Application Rates and Timing on Nitrogen Management and Processing Tomato Productivity and Quality" and collaboration from Drs. Zheng Wang (UCANR) and Costanza Zavalloni (CSU-Stanislaus).* *As results become available they will be distributed in future issues of this newsletter as well as online: http://cestanislaus.ucanr.edu/. No endorsement of named companies or products is intended nor is criticism implied of similar products or companies which are not mentioned.*

Photo 1. Compost application to Field One-North and Field Two-South on October 30, 2019.

Photo 2. Compost on soil surface prior to tillage incorporation to a 6" depth.

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