

TEXAS A&M AGRI LIFE EXTENSION

Texas A&M AgriLife 2020 and 2021

Bushland Herbicide Trials



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Introduction

Weeds use essential crop water and nutrients that are necessary to optimize yields. In the Texas High Plains, more than 50% of the yearly water requirement for crops such as corn is supplemented by irrigation from the declining Ogallala Aquifer. Dependence on irrigation makes timely weed control important to enhance crop water use efficiencies and maximize yields. Herbicides are recognized as a method to enhance crop water use efficiencies by eliminating weeds and competition for resources. Resistant and herbicide tolerant weed species have become a problem in the Texas High Plains. Hard to control weeds require critical evaluation of herbicide programs that include preplant burndown, use of residual herbicides, and the timing of in-season applications as well as using labeled application volumes. Commercially available herbicides are evaluated in the Texas A&M AgriLife herbicide trials at the Texas A&M AgriLife James Bush Research Farm and the USDA-ARS Conservation and Research Production Laboratory at Bushland, Texas (Figure 1) to evaluate herbicide efficacy under regional conditions. This publication includes herbicide tank-mixes evaluated in corn, cotton, and wheat herbicide trials that were evaluated in 2020 and 2021. Herbicides used in these trials are marketed for Texas High Plains production and approved for use in the respective crops in Texas by the United States Environmental Protection Agency.

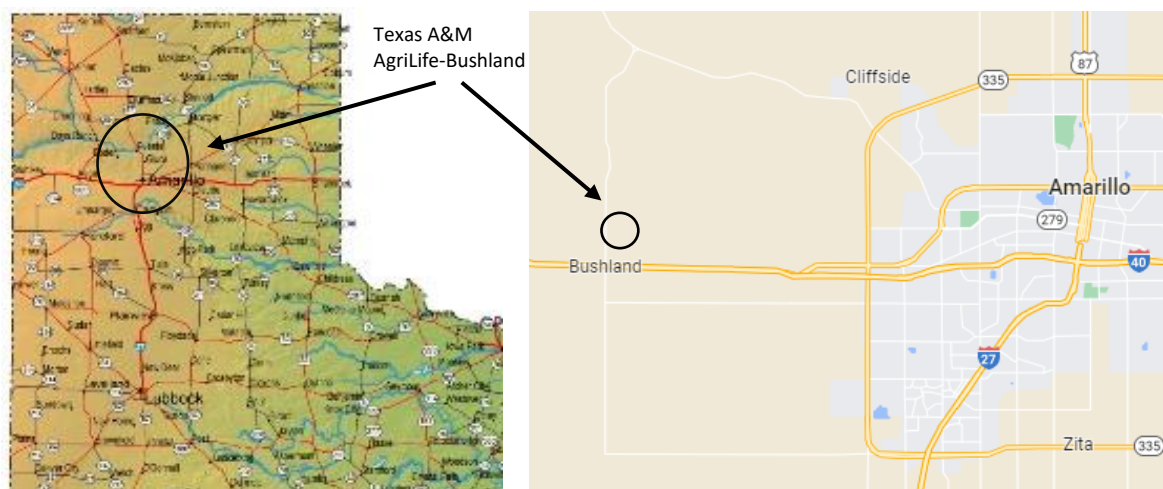


Figure 1. Texas A&M AgriLife James Bush Research Farm location in the Texas Panhandle

Section 1: 2020 and 2021 Corn, Cotton, and Wheat Herbicide Trials

Corn Trials

Herbicide treatments evaluated in the 2020 and 2021 Bushland corn herbicide trials (Tables 1-12) were provided by industry partners: AMVAC, Bayer, BASF, FMC, Summit, and Syngenta. Research was conducted at the Texas A&M AgriLife James Bush Research Farm at Bushland, Texas. All treatments were replicated using a commercially available corn hybrid P0157AMAQ LLRR2 planted on April 17, 2020, at 24,500 seeds per acre. All treatments were replicated in 2021 using Syngenta corn hybrid NK1082-5222A planted on April 20 at 25,000 seeds per acre. Plots were fertilized for a predetermined yield goal based on soil test results prior to planting, and plots were irrigated at a deficit rate throughout the growing season. In 2020, there were 6 irrigation events totaling 13 inches of applied water with 2.4 inches of rainfall from May 2 to July 14 (Figure 2) when the trial was terminated. In 2022, there were 3

irrigation events totaling 8.76 inches of applied water with 7.75 inches of rainfall from April 20 to July 5 (Figure 3) when the trial was terminated. Plots were sprayed with an application volume of 15 gallon/acre using a Lee Agra Spider broadcast sprayer with flat-fan nozzles at 40 PSI on 15-inch spacing. All treatments were assessed against an untreated check to evaluate herbicide efficacy and crop phytotoxicity. Reported weed control is an average of ratings for all plots within a treatment at a specified number of days post herbicide application. In 2020, preemergent applications were applied on April 17 and postemergent applications, at the 2-4 inch weed stage, were applied on May 21. In 2021, preemergent applications were applied on April 21 and postemergent applications, at the 2-4 inch weed stage, were applied on May 25.

Cotton Trials

Herbicide treatments evaluated in the 2020 and 2021 Bushland cotton herbicide trials (Tables 13 & 14) were provided by industry partner Syngenta. All treatments were replicated using a commercially available cotton variety DP1820B3XF in 2020, and NG 3500XF in 2021 at the Texas A&M AgriLife James Bush Research Farm at Bushland, Texas. Plots were fertilized for a predetermined yield goal based on soil test results prior to planting, and plots were irrigated at a deficit rate throughout the growing season. In 2020 there were 6 irrigation events totaling 11.9 inches of applied water with 3.9 inches of rainfall from June 6 to August 19 (Figure 4) when the trial was terminated. In 2021 there were 3 irrigation events totaling 7.9 inches of applied water with 6.6 inches of rainfall from May 26 to August 18 (Figure 5) when the trial was terminated. Plots were sprayed using the same volume and sprayer as the corn herbicide plots. All treatments were assessed against an untreated check to evaluate herbicide efficacy and crop phytotoxicity and reported as an average for all replicated plots at a specified number of days post herbicide application. Cotton was planted on May 28, 2020, at 35,000 seeds/acre and May 25, 2021, at 37,500 seeds/acre. Preemergent applications were applied at planting, and postemergent applications were applied at the 2-4 inch weed stage.

Wheat Trial

Herbicide treatments evaluated in the 2020 Bushland wheat herbicide trial (Table 15) were provided by industry partner Syngenta. All treatments were replicated using the commercially available wheat variety TAM 113 at the USDA-ARS Farm at Bushland, Texas in a dryland (Figure 6) production system. Plots were sprayed using the same volume and sprayer as the corn, sorghum, and cotton herbicide plots. All treatments were assessed against an untreated check to evaluate herbicide efficacy and crop phytotoxicity, which were assessed as an average of all replicated plots at a specified number of days post herbicide application. Wheat was planted on October 15, 2019, at 30 pounds per acre and emerged on October 25. Postemergent applications were applied on March 12, 2020, at the 2-4 inch weed stage when wheat was at Feekes 6. Preemergent herbicides were not used in this study.

Weed Species Targeted

Weeds targeted in the Bushland herbicide trials include redroot pigweed (*Amaranthus retroflexus*), Palmer Amaranth (*Amaranthus palmeri*), tumble pigweed (*Amaranthus albus*), kochia (*Kochia scoparia*), Russian thistle (*Salsola iberica*), barnyardgrass (*Echinochloa crus-galli*), windmill grass (*Chloris verticillata*), and witchgrass (*Panicum capillare*). Weed populations vary between years. Primary weeds targeted in the 2019-2020 Bushland wheat herbicide trials located at the USDA-ARS farm were tansy mustard (*Descurainia pinnata*) and blackseed plantain (*Plantago fugelli*). In the 2021 herbicide plots established in April, May, and June, the primary weeds were *Amaranthus* species across all trials with moderate grass and kochia pressure. In the 2020 herbicide plots established in April, the primary weed was Kochia with moderate grass and *Amaranthus* species pressure. Crop rotational intervals are

reported (Table 16) for the herbicides that are commonly evaluated in the Bushland herbicide trials that target the primary weed species listed.

Acknowledgements

We gratefully acknowledge the assistance of students Shelby Lain, Layney Miller-Reynolds, and Garyn Miller with herbicide applications and plot maintenance.

Table 1. AMVAC 2020 Bushland Corn Herbicide Trial

Primary Company Protocol - AMVAC-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 15 days after Post				% Control 36 days after Post				% Control 53 days after Post					
Treatment	Rate	Herbicide app timing	% Control				% Control				% Control						
			% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds			
1	Untreated Check	NA	NA														
2	Impact CORE	1.9 pt/a	Post 2-4" weeds Corn V2-V3	0	100	100	99	0	92	98	90	0	88	96	73		
	Atrazine	1 qt/a															
	NIS	4.8 fl oz/a															
	AMS	2.5 lb/a															
3	Impact CORE	1.25 qt/a	Post 2-4" weeds Corn V2-V3	0	100	100	98	0	97	100	89	0	92	99	79		
	Atrazine	1 qt/a															
	NIS	4.8 fl oz/a															
	AMS	2.5 lb/a															
4	Impact CORE	1.9 pt/a	Post 2-4" weeds Corn V2-V3	0	100	100	100	0	99	99	100	0	97	97	98		
	Atrazine	1 qt/a															
	Roundup	1 qt/a															
	NIS	4.8 fl oz/a															
5	Impact CORE	1.25 qt/a	Post 2-4" weeds Corn V2-V3	0	100	100	100	0	99	100	100	0	98	100	99		
	Atrazine	1 qt/a															
	Roundup	1 qt/a															
	NIS	4.8 fl oz/a															
6	Halex GT	1.8 qt/a	Post 2-4" weeds Corn V2-V3	0	100	100	100	0	97	99	97	0	93	97	96		
	Atrazine	1 qt/a															
	NIS	4.8 fl oz/a															
	AMS	2.5 lb/a															

Table 2. AMVAC 2021 Bushland Corn Herbicide Trial

Primary Company Protocol - AMVAC-Corn NK1082-5222A planted on 4-20-21				% Control 44 days after Pre 1 day Post V2-V3				% Control 58 days after Pre 15 days after Post V4				% Control 76 days after Pre 33 days after Post V4			
Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
			1	Untreated Check	NA	NA									
2	Impact CORE	1.4 pt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	
	Atrazine	1.5 qt/a													
	Roundup PowerMax	1 qt/a													
	NIS	0.25 % v/v													
	AMS	2.5 lb/a													
3	Liberty	1 qt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	97	100	0	100	97	100
	AMS	3 lb/a													
4	Sinate	1.4 pt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	99	100	0	99	99	100
	MSO	1 % v/v													
	AMS	3 lb/a													
5	Sinate	1.4 pt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Atrazine	1 pt/a													
	MSO	1 % v/v													
	AMS	3 lb/a													
6	Sinate	1.4 pt/a	Post 2-4" weeds Corn V2-V3	5	100	99	100	0	100	99	100	0	100	99	100
	Dual II Magnum	1.5 pt/a													
	MSO	1 % v/v													
	AMS	3 lb/a													
7	Sinate	1.4 pt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Dual II Mag	1.5 pt/a													
	AAtrex	1 pt/a													
	MSO	1 % v/v													
	AMS	3 lb/a													
8	Bicep II Mag	1.6 qt/a	Pre @planting	5	100	91	100								
	Sinate	1.4 pt/a	Post 4-6" weeds Corn V4				0	100	99	100	0	99	99	100	
	MSO	1 % v/v													
	AMS	3 lb/a													
9	Dual II Mag	1.6 qt/a	Pre @planting	5	100	98	100								
	Sinate	1.4 pt/a	Post 4-6" weeds Corn V4				0	100	100	100	0	100	100	100	
	Atrazine	1 qt/a													
	MSO	1 % v/v													
	AMS	3 lb/a													
10	Bicep II Mag	1.6 qt/a	Pre @planting	5	100	98	99								
	Sinate	1.7 pt/a	Post 4-6" weeds Corn V4				0	100	99	100	0	100	100	100	
	MSO	1 % v/v													
	AMS	3 lb/a													

Table 3. BASF 2020 Bushland Corn Herbicide Trial

Primary Company Protocol -BASF-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 33 days after Pre 0 days after Post				% Control 49 days after Pre 15 days after Post				% Control 63 days after Pre 29 days after Post						
Treatment	Rate	Herbicide app timing	% Crop Injury				% Crop Injury				% Crop Injury							
			Kochia	Palmer	Grass Weeds		Kochia	Palmer	Grass Weeds		Kochia	Palmer	Grass Weeds					
1	Check	NA	NA															
2	Verdict	10 fl oz/a	Pre @planting				0	85	74	76								
	Atrazine 4L	1 qt/a																
	Liberty 280 SL	1 qt/a	Post 2-4" weeds								0	100	100	99	0	100	99	98
	Atrazine	1 qt/a	Corn V2-V3															
	AMS	3 lb/a																
3	Verdict	10 fl oz/a	Pre @planting				0	71	65	64								
	Atrazine 4L	1 qt/a																
	Liberty 280 SL	1 qt/a	Post 2-4" weeds								0	100	100	100	0	100	99	99
	Armazon Pro	1 pt/a	Corn V2-V3															
	Atrazine	1 qt/a																
4	AMS	3 lb/a																
	Verdict	10 fl oz/a	Pre @planting				0	75	70	48								
	Atrazine 4L	1 qt/a																
	Liberty 280 SL	1 qt/a	Post 2-4" weeds								3	100	100	100	0	100	100	100
	Armazon Pro	1 pt/a	Corn V2-V3															
5	Atrazine	1 qt/a																
	MSO	1 % v/v																
	AMS	3 lb/a																
	Verdict	10 fl oz/a	Pre @planting				0	75	70	60								
	Atrazine 4L	1 qt/a																
6	Roundup Power Max	1 qt/a	Post 2-4" weeds								3	100	100	100	0	100	100	100
	Armazon Pro	1 pt/a	Corn V2-V3															
	Atrazine	1 qt/a																
	MSO	1 % v/v																
	AMS	3 lb/a																
7	Verdict	10 fl oz/a	Pre @planting				0	81	78	45								
	Atrazine 4L	1 qt/a																
	Liberty 280 SL	1 qt/a	Post 2-4" weeds								0	100	100	100	0	100	100	97
	Status	2.5 oz wt/a	Corn V2-V3															
	Atrazine	1 qt/a																
8	AMS	3 lb/a																
	Verdict	10 fl oz/a	Pre @planting				0	76	66	48								
	Atrazine 4L	1 qt/a																
	Roundup Power Max	1 qt/a	Post 2-4" weeds								0	100	100	100	0	100	100	98
	Status	2.5 oz wt/a	Corn V2-V3															
8	Atrazine	1 qt/a																
	AMS (21%N)	3 lb/a																
	Acuron	1.25 qt/a	Pre @planting				0	55	39	48								
	Liberty 280 SL	1 qt/a																
8	Status	2.5 oz wt/a	Post 2-4" weeds								0	100	100	100	0	100	100	97
	Atrazine	1 qt/a	Corn V2-V3															
	AMS	3 lb/a																

Table 4. Bayer 2020 Bushland Corn Herbicide Trial

Primary Company Protocol -Bayer-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 33 days after Pre 0 days after Post				% Control 49 days after Pre 15 days after Post				% Control 63 days after Pre 29 days after Post				
Treatment	Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds		
			1	Untreated	NA											
2	Warrant	1.5 qt/a	Pre @planting	0	92	93	100	0	89	85	99	0	88	79	93	
	Atrazine	1 qt/a														
3	Corvus	3.8 fl oz/a	Pre @planting	0	95	96	100	0	88	89	100	0	88	85	98	
	Atrazine	1 qt/a														
4	Corvus	5.6 fl oz/a	Pre @planting	0	95	98	100	0	88	95	100	0	80	95	99	
	Atrazine	1 qt/a														
	Warrant	1.5 qt/a														
5	Roundup Power max	1 qt/a	Post 2-4" weeds Corn V2-V3	0	0	0	0	0	100	100	100	0	99	100	100	
	Laudis	1.9 fl oz/a														
	Atrazine	1 qt/a														
	Warrant	1.5 qt/a														
	Superb HC	0.5 % v/v														
	N-Pak AMS	2.5 % v/v														
6	Balance Flexx	3 oz/a	Pre @planting	0	97	97	99									
	Atrazine	1 qt/a														
	Warrant	1.5 qt/a														
	Laudis	1 qt/a	Post 2-4" weeds Corn V2-V3						0	100	100	100	0	100	100	
	Atrazine	1 pt/a														
	Roundup Power max	1 qt/a														
	Superb HC	0.5 % v/v														
AMS	6 lb/a															
7	Balance Flexx	3 oz/a	Pre @planting	0	74	86	100									
	Warrant	1.25 qt/a														
	Laudis	3 oz/a	Post 2-4" weeds Corn V2-V3						0	97	100	100	0	96	100	100
	Warrant	1.25 qt/a														
	Roundup Powe	1 qt/a														
	SUPERB HC	0.5 % v/v														
AMS	6 lb/a															
8	Balance Flexx	3 oz/a	Pre @planting	0	93	95	100									
	Atrazine	1 qt/a														
	Laudis	3 oz/a	Post 2-4" weeds Corn V2-V3						0	100	100	100	0	100	100	
	Atrazine	1 pt/a														
	Roundup Power max	1 qt/a														
	Superb HC	0.5 % v/v														
AMS	6 lb/a															
9	Resicore	1.25 qt/a	Pre @planting	0	85	93	100									
	Atrazine	1 pt/a														
	Resicore	1.25 qt/a	Post 2-4" weeds Corn V2-V3						0	99	100	100	0	99	100	97
	Atrazine	1 pt/a														

Table 5. Bayer 2021 Bushland Corn Herbicide Trial

Primary Company Protocol -Bayer-Corn NK1082-5222A planted on 4-20-21				% Control 44 days after Pre 10 days after Post				% Control 58 days after Pre 24 days after Post				% Control 76 days after Pre 42 days after Post			
Treatment	Rate	Herbicide app timing	% Control				% Control				% Control				
			% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Untreated	NA													
2	Corvus	3.3 fl oz/a	Pre @planting	5	100	100	99	0	100	99	99	0	100	99	100
	Warrant	1.5 qt/a													
3	Corvus	3.3 fl oz/a	Pre @planting	5	100	100	100	0	100	99	100	0	100	99	100
	Warrant	1.5 qt/a													
	Atrazine	1 qt/a													
4	Roundup PowerMax	1 qt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Laudis	3 fl oz/a													
	Warrant	1.5 qt/a													
	Atrazine	1 qt/a													
	Superb HC	0.5 % v/v													
	N-Pak AMS	2.5 % v/v													
5	Balance Flexx	3 fl oz/a	Pre @planting	5	100	100	100	0	100	100	100	0	100	100	100
	Warrant	1.5 qt/a													
	Laudis	3 fl oz/a	Post 2-4" weeds Corn V2-V3												
	Atrazine	1 qt/a													
	Roundup PowerMax	1 qt/a													
	AMS	1.27 lb/a													
	Superb HC	0.5 % v/v													
6	Balance Flexx	3 fl oz/a	Pre @planting	5	100	100	100	0	100	100	100	0	100	100	100
	Warrant	1.5 qt/a													
	Atrazine	1 qt/a	Post 2-4" weeds Corn V2-V3												
	Laudis	3 fl oz/a													
	Roundup PowerMax	1 qt/a													
	AMS	1.27 lb/a													
	Superb HC	0.5 % v/v													

Table 6. FMC 2020 Bushland Corn Herbicide Trial

Primary Company Protocol -FMC-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 14 Days after Pre				% Control 33 Days after Pre				% Control 63 Days after Pre			
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds
1	Check	NA	NA												
2	Anthem Maxx	4 fl oz/a	Pre @planting	0	100	100	100	0	95	95	99	0	81	81	85
	Callisto	3 fl oz/a													
	Atrazine	1 qt/a													
	COC	1% v/v													
3	Acuron	2.5 qt/a	Pre @planting	0	100	100	100	0	95	95	99	0	84	83	87
	COC	1% v/v													

Table 7. FMC 2021 Bushland Corn Herbicide Trial

Primary Company Protocol -FMC-Corn NK1082-5222A planted on 4-20-21				% Control 44 days after Pre				% Control 58 days after Pre				% Control 76 days after Pre			
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds
1	Untreated	NA	NA												
2	Atrazine	1 qt/a	Pre @planting	0	100	98	99	0	100	96	99	0	100	92	99
	Callisto	3 fl oz/a													
	COC	1% v/v													
3	Atrazine	1 qt/a	Pre @planting	0	100	100	100	0	100	99	100	0	100	99	100
	Calisto	3 fl oz/a													
	Dual Magnum	1.5 qt/a													
	COC	1% v/v													
4	Atrazine	1 qt/a	Pre @planting	0	100	99	100	0	100	98	100	0	100	98	100
	Callisto	3 fl oz/a													
	Outlook	1 pt/a													
5	Atrazine	1 qt/a	Pre @planting	0	100	99	100	0	100	99	99	0	100	99	99
	Callisto	3 fl oz/a													
	Anthem Maxx	4 fl oz/a													
	COC	1% v/v													
6	Resicore	2.5 qt/a	Pre @planting	0	100	99	100	0	100	99	99	0	100	99	99

Table 8. Summit 2020 Bushland Corn Herbicide Trial

Primary Company Protocol -Summit-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 33 days after Pre 0 days after Post				% Control 49 days after Pre 15 days after Post				% Control 63 days after Pre 29 days after Post			
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds
1	Check	NA	NA												
2	Bicep II Mag.	1.7 qt/a	Pre @planting	0	99	96	99	0	99	89	95	0	99	71	93
3	Bicep II Mag.	1.7 qt/a	Pre @planting	0	99	97	99								
	Shieldex Atrazine	1 fl oz/a 1 pt/a	Post 2-4" weeds Corn V2-V3					0	99	97	97	0	99	91	97
4	Bicep II Mag.	1.7 qt/a	Pre @planting	0	97	96	98								
	Impact Atrazine	1 fl oz/a 1 pt/a	Post 2-4" weeds Corn V2-V3					0	100	98	97	0	99	90	93
5	Bicep II Mag.	1.7 qt/a	Pre @planting	0	99	95	99								
	Laudis Atrazine	3 fl oz/a 1 pt/a	Post 2-4" weeds Corn V2-V3					0	99	95	96	0	99	85	95

Table 10. Summit (2nd trial) 2021 Bushland Corn Herbicide Trial

Primary Company Protocol -Summit-Corn NK1082-5222A planted on 4-20-21				% Control 44 days after Pre 10 days after Post				% Control 58 days after Pre 24 days after Post				% Control 76 days after Pre 42 days after Post			
Treatment	Rate	Herbicide app timing	% Control				% Control				% Control				
			% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Untreated	NA													
2	Bicep II Mag	1.7 qt/a	Pre @planting				5 100 99 98				0 100 95 99				
3	Bicep II Mag	1.7 qt/a	Pre @planting												
	Shieldex	1 fl oz/a	Post 2-4" weeds				5 100 100 100				0 100 100 100				
	Atrazine	1 qt/a	Corn V2-V3												
	COC	1 % v/v													
4	Bicep II Mag	1.7 qt/a	Pre @planting												
	Impact	0.75 fl oz/a	Post 2-4" weeds				5 100 100 99				0 100 99 100				
	Atrazine	1 qt/a	Corn V2-V3												
	COC	1 % v/v													
5	Bicep II Mag	1.7 qt/a	Pre @planting												
	Laudis	3 fl oz/a	Post 2-4" weeds				5 100 100 99				0 100 99 99				
	Atrazine	1 qt/a	Corn V2-V3												
	COC	1 % v/v													
6	Bicep II Mag	1.7 qt/a	Pre @planting												
	Shieldex	1 fl oz/a	Post 2-4" weeds				5 100 100 99				0 100 100 100				
	Atrazine	1 qt/a	Corn V2-V3												
	Roundup Powe	1.9 pt/a													
7	Bicep II Mag	1.7 qt/a	Pre @planting												
	Shieldex	1 fl oz/a	Post 2-4" weeds				5 100 100 100				0 100 100 100				
	Atrazine	1 qt/a	Corn V2-V3												
	Liberty 280 SL	1 qt/a													
	COC	1 % v/v													

Table 11. Syngenta 2020 Bushland Corn Herbicide Trial

Primary Company Protocol -Syngenta-Corn P0157AMAQ LLRR2 planted on 4-17-20				% Control 33 days after Pre 0 days after Post				% Control 49 days after Pre 15 days after Post				% Control 63 days after Pre 29 days after Post			
Treatment	Rate	Herbicide app timing	% Control				% Control				% Control				
			% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Check	NA	NA												
2	Acuron XR	1.5 qt/a	Pre @planting	0	90	96	100								
	Acuron XR	1.5 qt/a	Post 2-4" weeds Corn V2-V3												
	Roundup Powermax	1.75 pt/a						0	100	100	100	0	100	100	100
	N-PAK AMS	2.5 % v/v													
3	Balance Flexx	3 fl oz/a	Pre @planting	0	93	84	100								
	Atrazine	1 pt/a	Post 2-4" weeds Corn V2-V3												
	Laudis	3 fl oz/a													
	Roundup Powermax	1.75 pt/a						0	99	100	100	0	98	99	100
	N-PAK AMS	2.5 % v/v													
4	Resicore	1.25 qt/a	Pre @planting	0	94	95	100								
	Atrazine	1 pt/a	Post 2-4" weeds Corn V2-V3												
	Resicore	1.25 qt/a													
	Roundup Powermax	1.75 pt/a						0	100	100	100	0	100	100	100
	N-PAK AMS	2.5 % v/v													

Table 12. Syngenta 2021 Bushland Corn Herbicide Trial

Primary Company Protocol -Syngenta-Corn NK1082-5222A planted on 4-20-21				% Control 44 days after Pre 10 days after Post				% Control 58 days after Pre 24 days after Post				% Control 76 days after Pre 42 days after Post			
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds
1	Untreated	NA	NA												
2	Acuron XR	1.5 qt/a	Pre @planting												
	Amsol	2.5 % v/v	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Acuron XR	1.5 qt/a													
	Roundup PowerMax	1.75 pt/a													
3	Bicep II Mag	1.5 qt/a	Pre @planting												
	Amsol	2.5 % v/v	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Acuron GT	3.75 qt/a													
	NIS	0.25 % v/v													
4	Bicep II Mag	1.5 qt/a	Pre @planting												
	Amsol	2.5 % v/v	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Halex GT	2 qt/a													
	NIS	0.25 % v/v													
5	Resicore	1.5 qt/a	Pre @planting												
	Atrazine	1 pt/a	Post 2-4" weeds Corn V2-V3	5	100	100	100	0	100	100	100	0	100	100	100
	Amsol	2.5 % v/v													
	Resicore	1.25 qt/a													
	Roundup PowerMax	1.75 pt/a													

Table 13. Syngenta 2020 Bushland Cotton Herbicide Trial

Primary Company Protocol -Syngenta-Cotton DP1820B3XF planted on 5-28-20				% Control 28 days after Pre 0 days after Post				% Control 46 days after Pre 13 days after Post				% Control 61 days after Pre 28 days after Post			
Treatment	Rate	Herbicide app timing	% Control				% Control				% Control				
			% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	
1	Check	NA	NA												
2	Caparol 4L	1 qt/a	Pre @planting												
	Gramoxone	2 qt/a													
	NIS	0.25 % v/v	0	100	74	98									
	Tavium + vapor grip Roundup	1.75 qt/a 1 qt/a	Post 2-4" weeds 4 leaf Cotton						0	100	100	100	0	100	98
3	Dual Mag	1 pt/a	Pre @planting												
	Caparol 4L	1 qt/a													
	NIS	0.25 % v/v	0	100	95	98									
	Tavium + vapor grip Roundup	1.75 qt/a 1 qt/a	Post 2-4" weeds 4 leaf Cotton						0	98	97	98	0	100	98
4	Warrant	1.5 qt/a	Pre @planting												
	Gramoxone	1 qt/a													
	NIS	0.25 % v/v	0	100	98	98									
	Xtendimax Roundup	1.4 pt/a 1 qt/a	Post 2-4" weeds 4 leaf Cotton						0	100	100	100	0	100	100
5	Gramoxone	1 qt/a	Pre @planting												
	Caparol 4L	1 qt/a													
	NIS	0.25% v/v	0	100	85	97									
	Engenia Roundup	12.8 fl oz/a 1 qt/a	Post 2-4" weeds 4 leaf Cotton						0	98	82	76	0	100	93

Table 14. Syngenta 2021 Bushland Cotton Herbicide Trial

Primary Company Protocol -Syngenta-Cotton NG3500 XF planted on 5-25-21				% Control 29 days after Pre				% Control 50 days after Pre 13 days after Post				% Control 69 days after Pre 32 days after Post			
Treatment		Rate	Herbicide app timing	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds	% Crop Injury	Kochia	Palmer	Grass Weeds
1	Untreated	NA	NA												
2	Caparol 4 L	1 qt/a	Pre @planting	0	100	98	95								
	Gramoxone	1 qt/a													
	Tavium Plus VaporGrip	1.75 qt/a													
	Roundup PowerMax	1 qt/a	Cotton 10" tall 6-8 Leaf					0	100	99	99	0	100	98	93
	NIS	0.25 % v/v													
	Intact	0.5 % v/v													
3	Caparol 4 L	1 qt/a	Pre @planting	0	100	98	98								
	Dual Mag	1.1 pt/a													
	Gramoxone	1 qt/a													
	Tavium Plus VaporGrip	1.75 qt/a	Cotton 10" tall 6-8 Leaf					0	100	98	99	0	100	95	98
	Roundup PowerMax	1 qt/a													
	NIS	0.25 % v/v													
Intact	0.5 % v/v														
4	Caparol 4 L	1 qt/a	Pre @planting	0	99	97	98								
	Sequence	1.4 qt/a													
	Roundup PowerMax	10 fl oz/a													
	Tavium Plus VaporGrip	1.75 qt/a	Cotton 10" tall 6-8 Leaf					0	100	99	100	0	100	99	99
	Roundup PowerMax	1 qt/a													
	Intact	0.5 % v/v													
5	Caparol 4 L	1 qt/a	Pre @planting	0	100	97	93								
	Xtendimax w/VaporGrip	1.4 fl oz/a													
	Gramoxone	1 qt/a	Cotton 10" tall 6-8 Leaf					0	100	100	99	0	99	97	88
	Roundup PowerMax	1 qt/a													
	NIS	0.25 % v/v													

Table 15. Syngenta 2020 Bushland Wheat Herbicide Trial

Primary Company Protocol -Syngenta-Wheat TAM 113 planted on 10-25-19				% Control 13 Days after			% Control 28 Days after			% Control 42 Days after		
Treatment		Rate	Herbicide app timing	% Crop Injury	Tansymustard	Blackseed plantain	% Crop Injury	Tansymustard	Blackseed plantain	% Crop Injury	Tansymustard	Blackseed plantain
1	Check	NA	NA									
2	CoAct	2.75 fl oz/a	Post 2-4" weeds Wheat Feekes 6	0	73	100	0	100	100	0	100	100
	Talinor	13.7 fl oz/a										
	Agridex	1 % v/v										
3	Quelex	0.75 oz wt/a	Post 2-4" weeds Wheat Feekes 6	0	78	100	0	72	100	0	97	100
	Agridex	1 % v/v										
4	2,4-D Amine	1.5 pt/a	Post 2-4" weeds Wheat Feekes 6	0	80	100	0	90	100	0	90	100

Table 16. Rotational Intervals of Herbicides Commonly used and Evaluated in the Bushland Herbicide Trails.

Active Ingredient	Manufacturer	Corn	Cotton	Sorghum	Wheat
		months unless interval noted differently*			
2,4-D amine	Alligare	7 days	1	7 days	7 days
Aatrex	Syngenta	0	12	0	12
Acuron	Syngenta	0	10	10	4
Afforia	Corteva	2 wks-4 mos.	1 to 2	1	1 to 2
Anthem Maxx	FMC	0	4	11 to 18	4 to 6
Armezon Pro	BASF	0	9	9	18
Atrazine	Syngenta	0	12	0	12
Authority MTZ	FMC	4 to 18	12 to 18	12 to 18	4
Balance Flexx	Bayer	0	10	6	4
Basis Blend	Corteva	0	1	10	3
Bicep II Magnum	Syngenta	0	12	0	12
Bicep Lite II Magnum	Syngenta	0	12	0	12
Callisto	Syngenta	0	10	0	4
Caprino	Bayer	0	10	10	4
Caparol	Syngenta	5	5	6	6
Cinch ATZ	Corteva	0	12	0	4.5
Corvus	Bayer	0	10	9 to 17	4
Coyote	UPL	0	12	0	4.5
Clarity	BASF	0 to 4	1 to 4	0.5 to 4	1
Diflexx Duo	Bayer	0	10	0	4
Dual II Magnum	Syngenta	0	0	0	4.5
Durango	Corteva	0	0	0	0
Enlist Duo	Corteva	0	0	0	0
Engnia	BASF	0	0	4	4
Facet L	BASF	10	10	0	0
Gramoxine Inteon	Syngenta	0	0	0	0
Halex GT	Syngenta	0	10	0	4.5
Harness Xtra 5.6	Bayer	0	12	12	4
Huskie	Bayer	4	12	7 days	7 days
Hukie FX	Bayer	4	9	7 days	7 days
Imiflex	UPL	8.5	9	18	3
Impact	AmVac	0	9	9	3
Impact Core	AmVac	0	10	9	4
Impact Z	AmVac	0	12	9	12
Keystone NTX	Corteva	0	12	0	4
Laudis	Bayer	0	10	10	4
Liberty 280SL	Bayer	0	0	6	2
Lumax	Syngenta	0	18	0	4.5
Mocassin	UPL	0	0	0	4.5
Mocassin II Plus	UPL	0	0	0	4.5
Peak	Syngenta	1	10	0	0
Prequel	Corteva	1 to 10	18	10	4
Prowl	BASF	0	12	12	4
Realm Q	Corteva	0	10	10	4
Resicore	Corteva	0	12	10.5	4
Round-up Powermax	Bayer	0	0	0	0
Sequence	Syngenta	0	0	0	4.5
Sharpen	BASF	0	1.5 to 9	0 to 1	0 to 3
Shieldex	Summit	0	12	9	3
Solstice	FMC	0	10	0	4
Status	FMC	7 days	1	1	1
Sure Start II	Corteva	0	26	12	4
Talinor	Syngenta	0	10	10	1
Tavium plus vapor grip	Syngenta	0	0	6	4.5
Verdict	BASF	0	1.5 to 12	0	4
Warrant	Bayer	0	0	0	4
Xtendimax	Bayer	3.3	0	0	3.3
Zemax	Syngenta	0	12	0	4.5
Zidua	BASF	0	1 to 4	6 to 12	0 to 6

Section 2. Weather Data

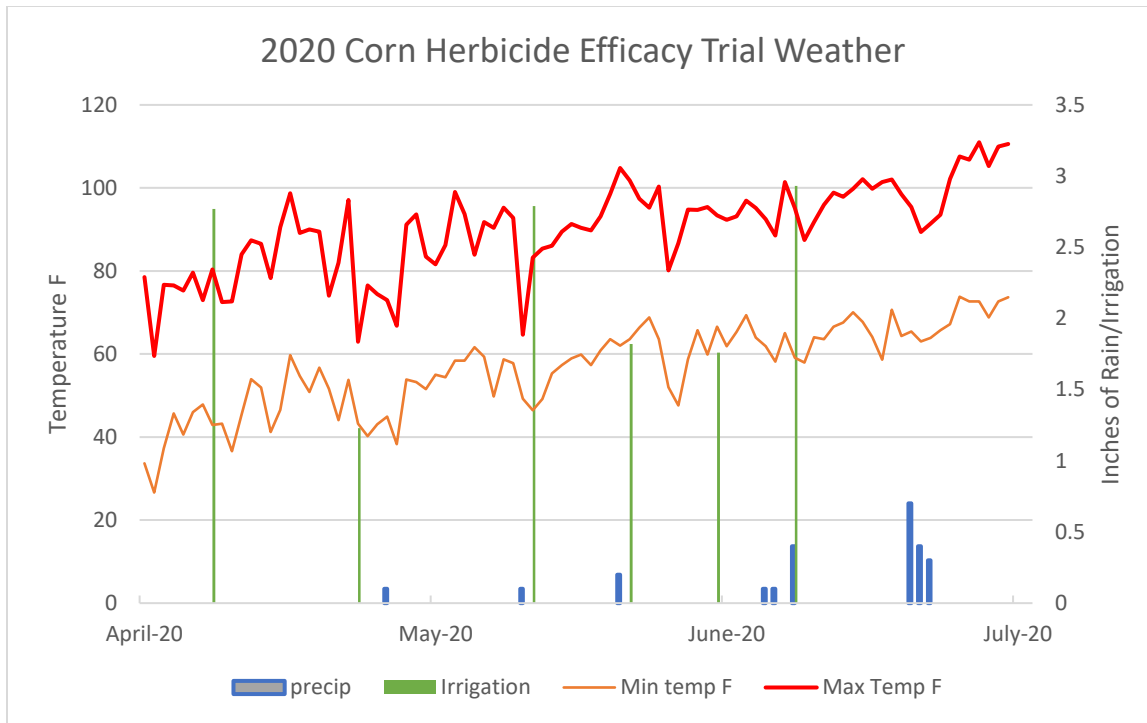


Figure 2. 2020 Corn Herbicide Efficacy Trial Weather

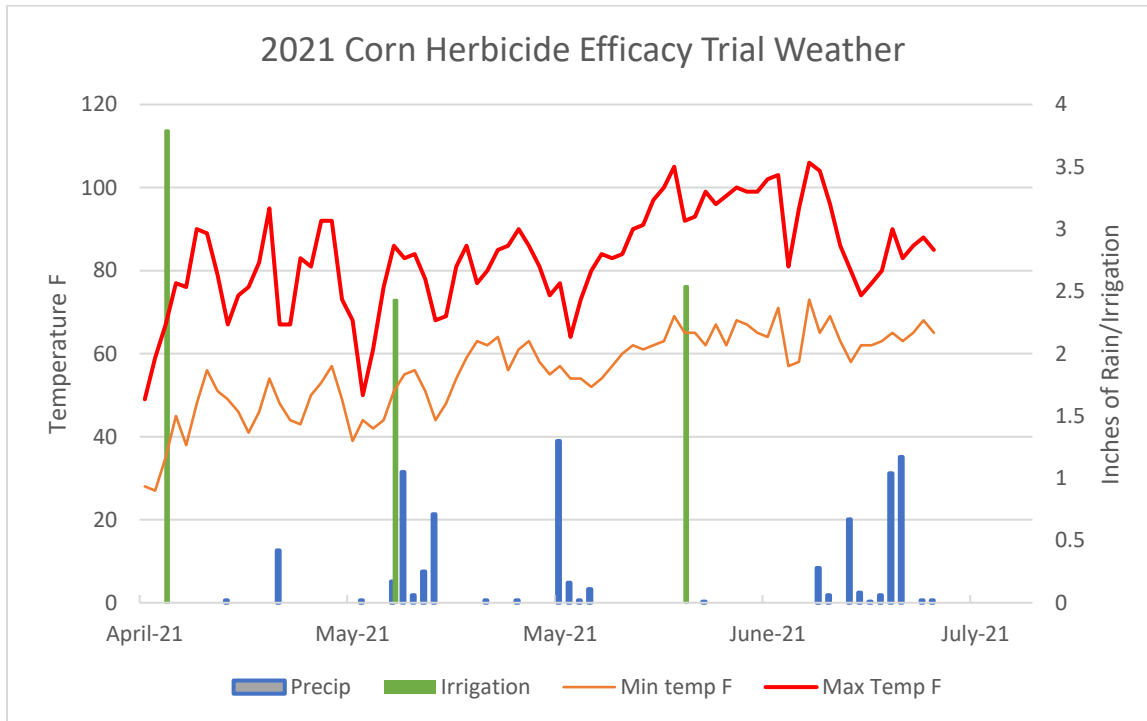


Figure 3. 2021 Corn Herbicide Efficacy Trial Weather

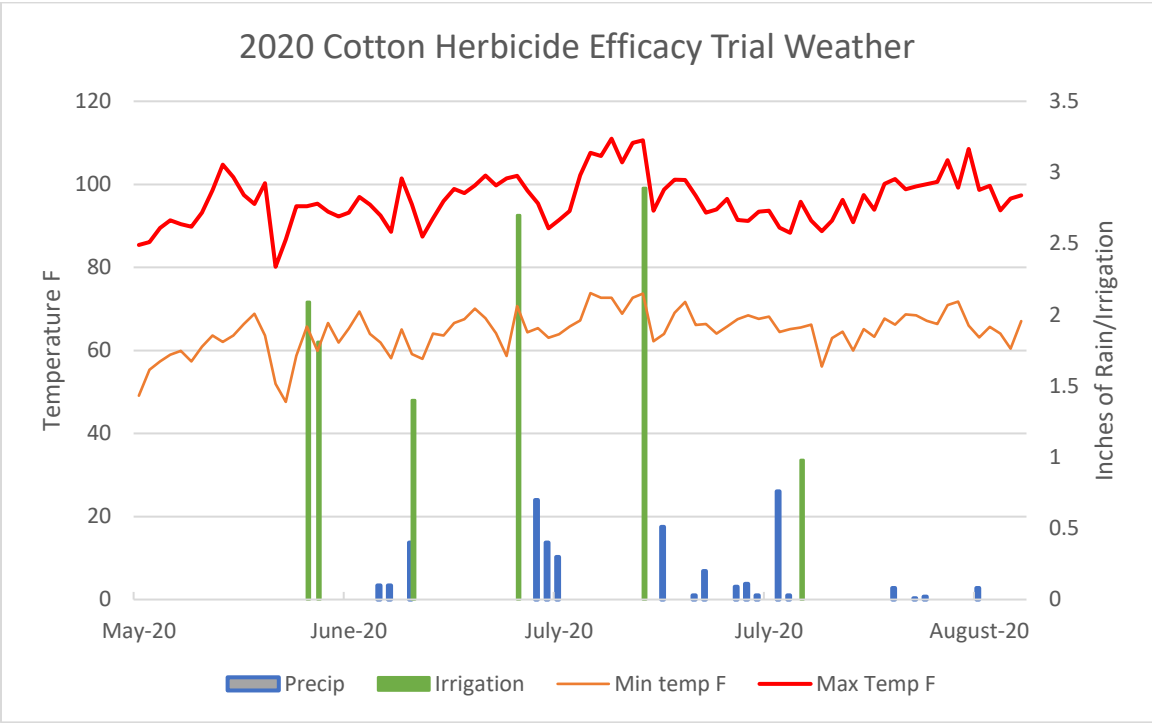


Figure 4. 2020 Cotton Herbicide Efficacy Trial Weather

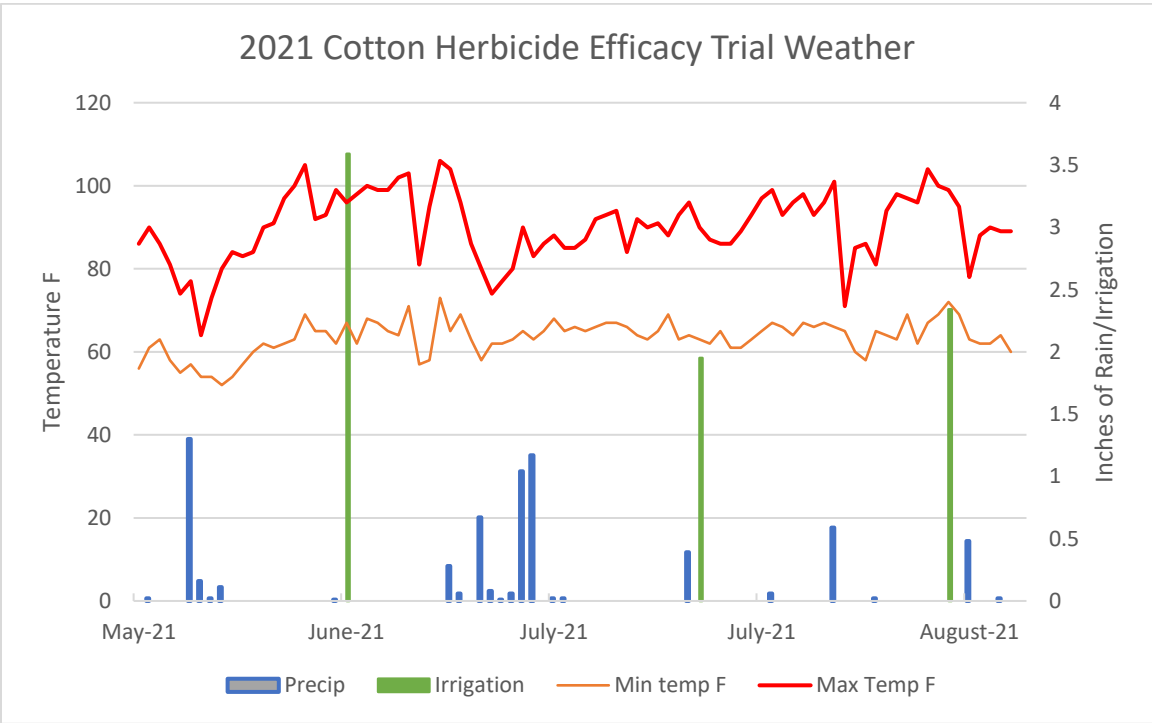


Figure 5. 2021 Cotton Herbicide Efficacy Trial Weather

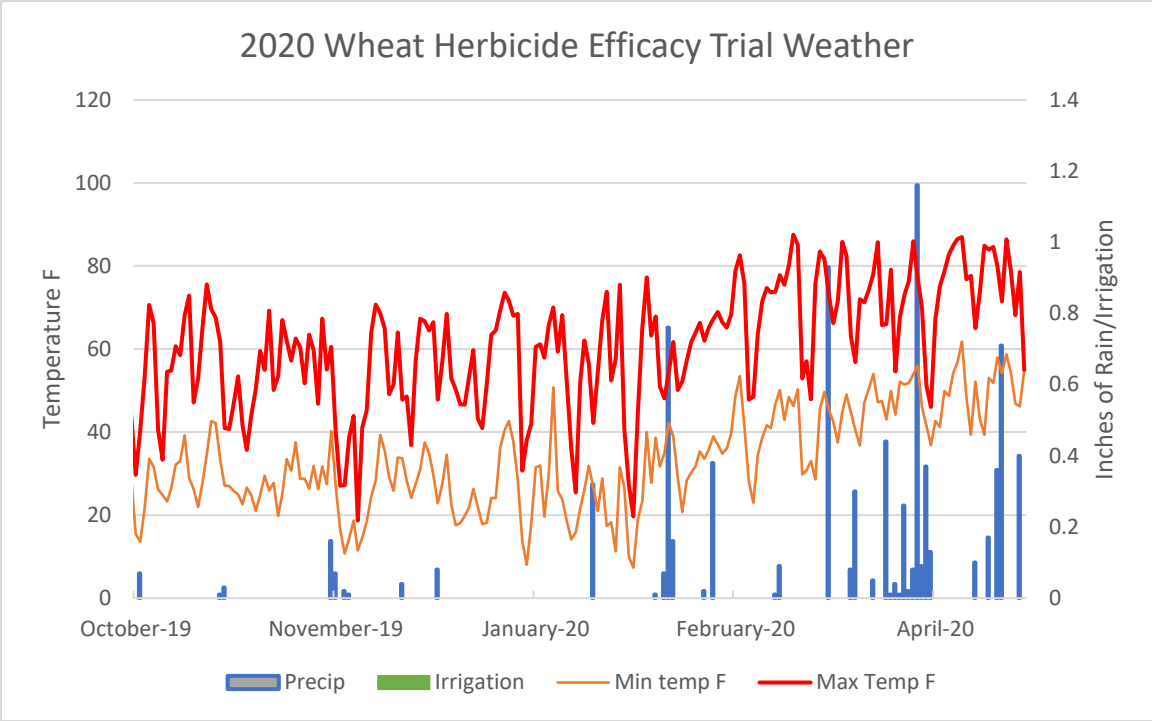


Figure 6. 2020 Wheat Herbicide Efficacy Trial Weather