Update on Tolerance of Chickpea to Paraquat Applied At-Cracking

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The objective of these studies was to evaluate chickpea crop tolerance to paraquat in a field setting and crop tolerance with the addition of a nonionic surfactant.

Both the 2016 and the repeated 2017 study were established at the Central Ferry Research Farm near Pomeroy, WA. Treatments were applied post emergence (POST) at several different crop stages, detailed in Table 1 and Table 2. The study was conducted in a randomized complete block with 4 replications with 10' by 30' long plots. Studies were planted with chickpea variety Billy bean using a Monosem planter on 10" row spacing at a depth of 1.5" on May 11, 2016 and May 1, 2017. Trial sites were supplemented with irrigation throughout the growing season. Lorox (2.5 lb A^{-1}) and Outlook (21 fl oz A^{-1}) were applied pre-emergence (PRE) to establish a weed free trial both years. The 2016 study was hand weeded July 5, 2016 due to heavy wild oat pressure. The 2017 study was not hand weeded. Irrigation was ended three weeks before harvest. Glyphosate at 32 fl oz A^{-1} with ammonium sulfate at 3 lb/100 gal was applied 14 days before harvest as a burn down application.

Fig 1. *Tolerance of chickpeas to paraquat. Top: Nontreated. Middle: Paraquat (8 fl oz A^{-1}) with NIS (0.25% v/v) applied at-cracking. Bottom: Paraquat (8 fl oz A^{-1}) with NIS (0.25% v/v) applied 4 days after cracking.*

Crop injury for the 2016 study was visually rated 2 and 51 days after treatment (DAT16) of application A (Table 2). Common lambsquarters (CHEAL) control was visually assessed 2 DAT16 of application A (Table 2). In 2017, crop injury was visually rated 12 and 25 days after treatment (DAT17) of application A (Table 2). Crop stand reduction was visually assessed 12 DAT17 of application A. Plant heights were also taken 25 DAT17. Plots were harvested using a Kincaid plot combine with a 5'-header on September 26, 2016 and August 24, 2017. All data were subjected to an analysis of variance using the statistical package built into the Agricultural Research Manager software system (ARM 8.5.0, Gylling Data Management).

In the 2016 study year, crop injury early on depended on application timing (Table 3). Crop injury 4 DAT16 for paraquat (73%) and paraquat with the addition of NIS (54%) applied 10 days after crop-cracking (application D) were significantly greater than the nontreated and the other paraquat treatments made at earlier days (Table 2). At 6 and 14 DAT16, significant crop injury was also present for treatments of paraquat (34%) and paraquat with NIS (36%) applied at 7 days after crop-cracking (application C) and paraquat (31%) applied at cracking (application A). Crop injury for all other treatments made at crop-cracking (application A) was not significantly different from the nontreated. By July 14, 2016, no crop injury was present for any application timing. There was no significant difference in common lambsquarters (CHEAL) control between treatments. Yield was similar between all treatments indicating chickpeas can regenerate after injury caused by paraquat when compared to a nontreated control in a weed-free environment (Table 3).

The repeated study in 2017, also observed that crop injury depended on application timing. Crop injury was greatest on May 30, 3017 for paraquat (8 fl oz A^{-1}) and paraquat (8 fl oz A^{-1}) with NIS applied 4 days after cracking with 21 and 30% crop injury, respectively. The same treatments applied 7 days after cracking as so had crop injury present on May 30, 2017 with 9% injury for paraquat at 8 fl oz A^{-1} and

14% injury for paraquat at 8 fl oz A^{-1} with NIS (Table 4). Stand reduction on May 20, 2017 was only observed in the 16 fl oz A^{-1} paraquat treatments at-cracking which had greater than 11% stand reduction compared to less than 1% reduction for all other treatments. On June 12, 2017 crop necrosis was lower for the later application timing of paraquat (8 fl oz A^{-1}) with and without NIS at 7 and 11 days after cracking compared to the other treatments. The treatments of 16 fl oz A^{-1} rate of paraquat at-cracking also had greater crop injury (greater than 48%) present on June 12, 2017. Plant heights were shorter for all treatments, except paraquat applied 11 days after cracking, on June 12, 2017 compared to the nontreated control. Yields were similar between all treatments and the nontreated control (Table 4).

Table 1. *2016 study treatment application details*

Study Application	**A**	**B**	**C**	**D**
Date	May 24, 2016	Not Applied	June 1, 2016	June 3, 2016
Application volume (GPA)	15		15	15
Crop stage	At Cracking		7 DA Crack	10 DA Crack
Air temperature (˚F)	59		62	78
Soil temperature (˚F)	57		64	70
Wind velocity (mph, direction)	7, S		9, S	4, NW
Next rain occurred on	June 10, 2016		June 10, 2016	June 10, 2016

Table 2. *2017 study treatment application details*

Study Application	**A**	**B**	**C**	**D**
Date	May 18, 2017	May 22, 2017	May 25, 2017	May 30, 2017
Application volume (GPA)	15	15	15	15
Crop stage	At Cracking	4 DA Crack	7 DA Crack	11 DA Crack
Crop size	Emerging	3.5”	6”	8”
Air temperature (˚F)	73	85	74	85
Soil temperature (˚F)	57	72	61	75
Wind velocity (mph, direction)	2, N	3, NW	5, E	6, N
Cloud Cover	5%	2%	60%	0%
Next rain occurred on	May 20, 2017	May 31, 2017	May 31, 2017	May 31, 2017

Table 3. *2016 study percent crop injury, pest pressure, and yield for chickpeas following applications of paraquat with and without a nonionic surfactant at different application timings. Central Ferry, WA, 2016. DAT = days after treatment for the 2016 study. Means followed by the same letter are not statistically significantly different (α=0.05).*

				June 7, 2016			*July 14, 2016 51 DAT*	*September 20, 2016*
Treatment	**Application Code**	**Rate**		**CHEAL Control**	**Crop Injury**		**Crop Injury**	**Yield**
		field rate	**lb ai/A**	**%**	**%**	**DAT**	**%**	**lb/A**
Nontreated		-	-	0	0 a	-	0	1140
Paraquat	A	8 fl oz/A	0.125	2	31 ab	14	10	1380
Paraquat NIS	A A	8 fl oz/A 0.25 % v/v	0.125	2	14 a	14	15	1390
Paraquat	B	8 fl oz/A	0.125	2	0 a	-	3	1320
Paraquat NIS	B B	8 fl oz/A 0.25 % v/v	0.125	1	1 c	-	10	1160
Paraquat	C	8 fl oz/A	0.125	1	34 ab	6	5	1110
Paraquat NIS	C C	8 fl oz/A 0.25 % v/v	0.125	2	36 ab	6	9	1250
Paraquat	D	8 fl oz/A	0.125	4	73 c	4	3	1390
Paraquat NIS	D D	8 fl oz/A 0.25 % v/v	0.125	4	54 bc	4	19	1090
Paraquat	A	16 fl oz/A	0.250	0	14 a	14	8	1390
Paraquat NIS	A A	16 fl oz/A 0.25 % v/v	0.250	0	14 a	14	1	1440
Sharpen NIS	A A	2 fl oz/A 0.25 % v/v	0.045	0	8 a	14	8	1330
			LSD	*NS*	*23.55*		*NS*	*NS*

Table 4. *2017 study percent crop injury, stand reduction, plant heights, and yield for chickpeas following applications of paraquat with and without a nonionic surfactant at different application timings. Central Ferry, WA, 2017. DAT = days after treatment for the 2017 study. Means followed by the same letter are not statistically significantly different (α=0.05).*

				May 30, 2017			*June 12, 2017*		*June 12, 2017 25 DAT*	*August 24, 2017*
Treatment	**Application Code**	**Rate**		**Crop Injury**	**Stand Reduction**	**DAT**	**Crop Necrosis**	**DAT**	**Plant Ht.**	**Yield**
		field rate	**lb ai/A**	**%**	**%**	**-**	**%**	**-**	**cm**	**lb/A**
Nontreated		-	-	-	-	-	-	-	35 a	1993
Paraquat	A	8 fl oz/A	0.125	8 b	1 a	12	28 abcde	25	30 bcd	2251
Paraquat NIS	A A	8 fl oz/A 0.25 % v/v	0.125	5 ab	0 a	12	28 abcde	25	31 bcd	2136
Paraquat	B	8 fl oz/A	0.125	21 d	1 a	8	38 bcdef	21	28 cd	2060
Paraquat NIS	B B	8 fl oz/A 0.25 % v/v	0.125	30 e	0 a	8	55 ef	21	28 d	1889
Paraquat	C	8 fl oz/A	0.125	9 bc	0 a	5	10 ab	18	30 bcd	2165
Paraquat NIS	C C	8 fl oz/A 0.25 % v/v	0.125	14 c	0 a	5	23 abcd	18	30 bcd	2174
Paraquat	D	8 fl oz/A	0.125	0 a	0 a	-	18 abc	13	33 ab	2154
Paraquat NIS	D D	8 fl oz/A 0.25 % v/v	0.125	0 a	0 a	-	13 ab	13	32 abc	1973
Paraquat	A	16 fl oz/A	0.250	10 bc	13 b	12	50 def	25	27 d	2158
Paraquat NIS	A A	16 fl oz/A 0.25 % v/v	0.250	5 ab	11 ab	12	48 cdef	25	27 d	2129
Sharpen NIS	A A	2 fl oz/A 0.25 % v/v	0.045	5 ab	24 c	12	60 f	25	24 e	2193
			LSD	*5*	*7*		*21*		*3*	*NS*

Disclaimer

Some of the pesticides discussed in this presentation were tested under an experimental use permit granted by WSDA. Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500. In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration. It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.