



**2021 Dry bean Western Bean cutworm trapping  
network report**

UNL PHREC Entomology Lab

Prepared for the Nebraska, Colorado, and Wyoming Dry Bean  
Commissions

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### **Executive Summary:**

The western bean cutworm is a primary pest of dry bean across the North American corn belt. Insecticides are typically used for its management. However, the improper use of insecticides may waste money and even increase the likelihood of damage. Therefore, proper management is crucial to the profitability of the dry bean industry. In the summers of 2020 and 2021, the Panhandle Research and Extension Center's Entomology Lab conducted a series of experiments to aid in the development of management strategies for the western bean cutworm. These include 1) developing a regional trapping network for western bean cutworm monitoring, 2) comparing the efficacy of four trap types, 3) comparing how pheromone change frequency affects trapping efficacy, and 4) comparing the effect of insecticide timing relative to crop phenology on western bean cutworm control. The details of this *2021 Trapping Report* can be summarized in the following points:

1. A regional trapping network is feasible; however, a new automated trap is needed since DTN no longer supports the camera or Zap traps
2. Green bucket traps seem to catch a greater number of moths than the decades' old milk jug standard. This is similar to our finding from 2020.
3. We do not detect any significant difference between moth capture and a two and four-week pheromone change. Thus, producers and crop consultants may save money on trap pheromone. This is similar to our finding from 2020.
4. No statistical difference was found among insecticide application timings regarding pod injury. However, other effects of insecticide timing are still being assessed.
5. We have set a tentative correlation between milk jug and camera trap captures at 57.2385
6. The Gering high school STEM class developed a trap that performs better than the camera traps
7. A new automated trap could be the "Bug-eater" manufactured by Ditto labs in Gering, Nebr.
8. More data has been acquired correlating WBC captures with feeding injury. However, a better correlation would be gained if WBC captures were made with a more effective trap. We have reason to believe that such a trap could be the "Bug eater" manufactured by Ditto Labs in Gering, NE.

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## Introduction:

The western bean cutworm (WBC) is a significant corn and dry bean pest. In both crops, feeding occurs upon the developing seed. The eggs are laid upon the top and bottom of corn and dry bean leaves, respectively. An average of fifty eggs are laid in a single mass (Fig. 1). Older larvae may be recognized by two dark rectangles behind the head (Fig. 2). Adults are moderately-sized moths. They may be recognized by a white stripe along the front of the forewing (Fig. 3a). Behind this is a white crescent (Fig. 3b) and a white dot (Fig. 3C).



Fig. 1 WBC egg mass  
| photo credit JD Cluever

Fig. 2 WBC larva | photo  
credit F. Peairs, CSU

Fig. 3 WBC adult | photo  
credit A. Sisson, ISU

Typically, control is achieved with an insecticide (**Table 1**). However, an unnecessary or ill-timed application of an insecticide can do more harm than good. It can increase the risk of injury by reducing natural enemy populations.

**Table 1:** Examples of insecticides registered for WBC control in dry bean\*

Active	Trade name(s) <sup>†</sup>	MOA	REI (hours)	PHI (days)
acephate & bifenthrin	Acenthrin <sup>†</sup>	1 & 3A	24	14
Bifenthrin	Battalion 2EC <sup>†</sup> ; Bi-Dash 2E <sup>†</sup> ; Bifen 2AG Gold <sup>†</sup> ; Bifenthrin 2EC <sup>†</sup> ; Bifenture EC <sup>†</sup> ; Brigade 2EC <sup>†</sup> ; Capture LFR <sup>†</sup> ; Fanfare EC <sup>†</sup> , 2EC <sup>†</sup> , ES <sup>†</sup> ; Frenzy Veloz <sup>†</sup> ; Reveal <sup>†</sup> , Endurx <sup>†</sup> ; Seguro <sup>†</sup> ; Sniper <sup>†</sup> , Helios <sup>†</sup> ; Tundra EC <sup>†</sup> ; Willowood Bifenthrin 2EC <sup>†</sup> ;	3A	12	14
Bifenthrin & <i>Bacillus amyloliquefaciens</i> strain D747	Ethos XB <sup>†</sup> ;	3A	12	14
Bifenthrin & Chlorantraniliprole	Elevest <sup>†</sup>	3A & 28	12	14
Carbaryl	Carbaryl 4L; Sevin, 4F, XLR Plus;	1A	12	21
chlorantraniliprole	Prevathon;	28	4	1
chlorpyrifos & bifenthrin	Match-up insecticide <sup>†</sup>	1B & 3A	24	14
Esfenvalerate	Asana XL <sup>†</sup> ; S-Fenvalostar insecticide <sup>†</sup> ;	3A	12	21

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	Zyrate <sup>r</sup>			
Flubendiamide	Belt SC	28	12	14
fluoxastrobin; bifenthrin	Tepera Plus <sup>r</sup>	3A	12	14
γ-cyhalothrin	Declare <sup>r</sup> ; Proaxis insecticide <sup>r</sup> ;	3A	24	21
λ-cyhalothrin	Cavalry II <sup>r</sup> ; Crusader 1EC <sup>r</sup> ; Firestone <sup>r</sup> ; Grizzly, Too <sup>r</sup> , Z insecticide <sup>r</sup> ; Kendo, 22.8 CS <sup>r</sup> , insecticide <sup>r</sup> ; L-C Insecticide <sup>r</sup> ; Lambda-T <sup>r</sup> ; Lambda-Cy, AG <sup>r</sup> , EC-insecticide RUP <sup>r</sup> ; LambdaStar, 1CS <sup>r</sup> , insecticide <sup>r</sup> , insecticide plus <sup>r</sup> ; lamcap II <sup>r</sup> ; Paradigm VC <sup>r</sup> ; Province <sup>r</sup> , II <sup>r</sup> ; Ravage <sup>r</sup> ; Serpent 1 EC <sup>r</sup> ; Silencer <sup>r</sup> , XVN <sup>r</sup> ; Warrior II with Zeon Technology <sup>r</sup> ; Willowood Lambda, 1EC <sup>r</sup> , CY 1EC <sup>r</sup>	3A	24	21
λ-cyhalothrin & chlorantraniliprole	Besiege <sup>r</sup>	3 & 28	24	21
Spinosad & γ-cyhalothrin	Consero <sup>r</sup> ;	3A & 5	24	28
ζ-cypermethrin & Bifenthrin	Hero EW <sup>r</sup> ; Steed insecticide = <sup>r</sup>	3A	12	21

\*Always check the label for specific restrictions before making application decisions. † Trade names are only stated for demonstration and do not reflect recommendations ‡ Restricted use pesticide

Scouting plans exist for corn; however, this is impractical in dry bean. Thus, pheromone trap catches are used to estimate the risk level. If fewer than seven hundred are caught in a trap until to peak flight, the risk is low. If seven hundred to a thousand are caught, the risk is moderate. If greater than one thousand are caught, the risk is high (Seymour et al. 2010).

At least two traps should be placed on each field (Seymour et al 2010). Traps should be at about four feet above the ground as higher placement may reduce catches (Mahrt et al., 1987; Seymour et al., 2010). Traps should be checked regularly.

Western bean cutworm moths overwinter in the soil. Emergence from the soil usually occurs in late June to early July. Degree-day models can predict this. See **table 2** below from UNL crop watch.

**Table 2:** Western bean cutworm degree-day accumulation (Excerpt from Cluever et al., 2021)

Municipality	Coordinates	Elev.	5%	10%	25%	50%	75%	90%	95%
Broadwater, NE	41.68 -102.87	4117	16-Jul	19-Jul	22-Jul	25-Jul	29-Jul	2-Aug	5-Aug
Brule, NE	41.02 -101.97	3474	10-Jul	13-Jul	16-Jul	19-Jul	23-Jul	27-Jul	30-Jul
Ft. Collins, CO	40.58 -105.15	1543	19-Jul	21-Jul	25-Jul	29-Jul	2-Aug	6-Aug	9-Aug
Garden City, KS	37.98 -100.82	2841	28-Jun	30-Jun	3-Jul	7-Jul	10-Jul	14-Jul	17-Jul
Holyoke, CO	40.48 -102.10	3694	12-Jul	14-Jul	18-Jul	21-Jul	25-Jul	29-Jul	1-Aug
Idalia, CO	39.72 -102.32	3930	9-Jul	11-Jul	14-Jul	18-Jul	22-Jul	25-Jul	28-Jul
Keystone, NE	41.18 -101.65	1033	10-Jul	12-Jul	15-Jul	19-Jul	22-Jul	26-Jul	29-Jul
Lamar, CO	37.97 -102.60	3734	2-Jul	4-Jul	8-Jul	11-Jul	15-Jul	19-Jul	21-Jul
North Platte, NE	41.08 -100.78	2841	10-Jul	12-Jul	16-Jul	19-Jul	23-Jul	26-Jul	30-Jul
Scottsbluff, NE	41.88 -103.68	3934	15-Jul	18-Jul	21-Jul	24-Jul	28-Jul	1-Aug	4-Aug

## **Methods:**

### **Fields:**

In 2021, we placed pheromone traps on thirteen fields across western Nebraska, two in Wyoming, and one in Colorado. These fields can be grouped into three types which will be referred to as “survey fields”, “compare fields”, “compare/insecticide fields” throughout this document.

### **Survey fields:**

Thirteen of the fields were “survey fields.” Four camera “Smart Traps” (DTN, Burnsville, MN) were placed on the edges of these fields. The field locations were chosen by representatives of dry bean companies. The approximate locations of the fields may be seen below (**Table 3**).

### **Compare field and insecticide/compare fields:**

Four fields in Scotts Bluff Co, Neb. were used to compare trap types (Compare and Compare/insecticide fields). The approximate locations may be seen below (**Table 3**). Traps types compared were traditional milk jug, universal green bucket, camera traps (“smart traps”), and prototype automated traps (Gering traps). Each field had two transects on opposite sides. Each transect had the four previously mentioned trap types spaced 200’ apart. (Note: Gering traps were only placed on the Mitchell 6N field and one transect of the Eighty field). We had initially intended on using zap traps (“Z-trap”) in our comparisons as we had in 2020. However, their service was discontinued by the manufacturer.

### **Traps:**

The Camera “Smart” Traps (**Figs. 4a-c**) have software capable of identifying insect pests from the photographs that it takes. Moths were captured on a sticky pad at the bottom of the trap (ISCA Technologies, Riverside, CA). The sticky pads were changed on a weekly basis.

The traditional milk jug trap is made from an empty one-gallon milk jug. Holes were cut into the sides to allow moths to enter (**Fig. 5**). The bottom was filled with a mixture of 75% water and 25% antifreeze (Prestone, Chicago, IL) along with dish soap (Proctor and Gamble, Cincinnati, OH). Additional mixture was added as needed (usually once every two days).

The universal green bucket trap (Great Lakes IPM, Vestaburg, MI) consists of a bucket that moths fly into (**Fig. 6**). Moths were dispatched with dichlorvos vapor tape.

The Gering trap was developed by Keaton Plummer and Justin Reinmuth of Gering High School. The Gering trap is based upon the universal green bucket trap and went through several iterations (**Fig. 7a-c**). For more information on the Gering trap, see our report titled “The development of an improved pheromone trap for western bean cutworm monitoring”. All traps had a WBC pheromone lure (Scentry Biologicals, Billings, MT) which was changed every two weeks.

**Table 3:** 2021 Western Bean cutworm trapping locations

Type	Field	Approximate location	Predominate soil type(s)	Market Class	Bean sample Harvest Date
Survey	Bayard 6N	41°50'N 103°18'W	Mitchell very fine sandy loam	Great Northern	7-Sep
Compare	Eighty	41°53'N 103°41'W	Tripp very fine sandy loam	Great Northern	9-Sep
Compare/ insecticide	Gering 2.5SE	41°48'N 103°36'W	Mitchell Silt loam; Otero-Bayard fine sandy loams	Great Northern	2-Sep
Survey	Gering 5SE	41°47'N 103°35'W	Otero-Bayard fine sandy loams; Jayem fine sandy loam	Great Northern	7-Sep
Survey	Grant 5N	40°54'N 101°42'W	Keith silt loam; Kuma silt loam	Kidney	No samples
Survey	Holyoke 2SE	40°33'N 102°16'W	Rago and Kuma loams; Platner loam; Haxtun sandy loam	Kidney	No samples
Survey	Imperial 6.5W	40°32'N 101°45'W	Vetal fine sandy loam; Tassel-Duda loamy sands; Jayem fine sandy loam	Pinto	No samples
Survey	Lamar 3.5W	40°33'N 102°02'W	Kuma Silt loam; Rosebud loam; Rosebud canyon loams	Kidney	No samples
Survey	Lingle 5W	42°09'N 104°26'W	Mitchell Silt loam; Harveson and McCook loams; Dunday and Dwyer fine sands	Ukn	No samples
Survey	Mitchell 3NE	41°58'N 103°45'W	Tripp very fine sandy loam; Alice fine sandy loam	Great Northern	31-Aug
Compare/ insecticide	Mitchell 4N	41°59'N 103°46'W	Scoville fine sandy loam;	Pinto	2-Sep

Survey	Morrill 3E	41°57'N 103°52'W	Alice Fine Sandy loam Harveson fine sandy loam; Yockey fine sandy loam	Great Northern	31-Aug
Survey	Paxton 9.5SW	41°02'N 101°30'W	Kuma loam; Satanta loam	Kidney	No samples
Survey	Ralston 6.5E	44°44'N 108°59'W	Ralston flats- Kamms complex; Eaglenest- Hiland complex	Ukn	No samples
Survey	Scottsbluff 1.5NE	41°52'N 103°38'W	McCook loam; Yockey loam	Pinto	31-Aug
Compare/ insecticide	Scottsbluff 6N	41°57'N 103°40'W	Mitchell silt loam	Great Northern	2-Sep
Survey	Scottsbluff 6W	41°51'N 103°47'W	Mitchell silt loam	Pinto	7-Sep

#### Moth Counts:

Traps (except for the camera “smart” traps) were checked daily from the 13<sup>th</sup> of July until the 11<sup>th</sup> of August (except for some weekends). The Gering traps were installed later and were not checked until the 21 and 27<sup>th</sup> of July at the Mitchell 4N and Eighty fields, respectively. The three-day rolling average was used in comparisons of trap types.

#### Insecticide Study

At three fields used for trap comparison (Gering 2.5SE, Mitchell 4N, and Scottsbluff 6N), we also evaluated insecticide application timings on natural enemy abundance and WBC control. The treatments were 1) no insecticide application, 2) at the same time as a pre-closure herbicide (15-Jul), 3) two weeks after peak WBC flight as per Nebraska Extension recommendations (6-Aug), and 4) at both times (15-Jul and 8-Aug) (Seymour et al., 2010). All applications were esfenvalerate (Asana XL, Valent, Walnut Creek, CA) at 9.6 fl oz acre<sup>-1</sup>. The study was replicated four times in a randomized complete block design (**Fig. 8**).

The presence of natural enemies was assessed with vacuum, sweep, and flower samples, and yellow sticky cards (**Table 4**). Vacuum samples were taken with a leaf blower (Echo, Lake Zurich, IL) fitted with a nylon sock. Sweep samples were taken with a 15.3-inch diameter sweep net. Three by five-inch sticky cards were placed just above ground level. Insects from these samples were preserved in 70% ethanol. Identification will be made with relevant taxonomic keys.



**Fig. 4a.** camera "Smart" trap | Photo Credit: JD Cluever



**Fig. 4b.** camera "Smart" trap camera | Photo Credit: JD Cluever



**Fig. 4c.** camera "Smart" trap sticky pad | Photo Credit: JD Cluever



**Fig. 5.** Milk Jug trap | Photo Credit: JD Cluever



**Fig. 6.** Green bucket trap | Photo Credit: JD Cluever



**Fig. 7a.** Gering trap iteration 1 | Photo Credit: JD Cluever



**Fig. 7b.** Gering trap iteration 2 | Photo Credit: JD Cluever



**Fig. 7c.** Gering trap iteration 3 | Photo Credit: JD Cluever

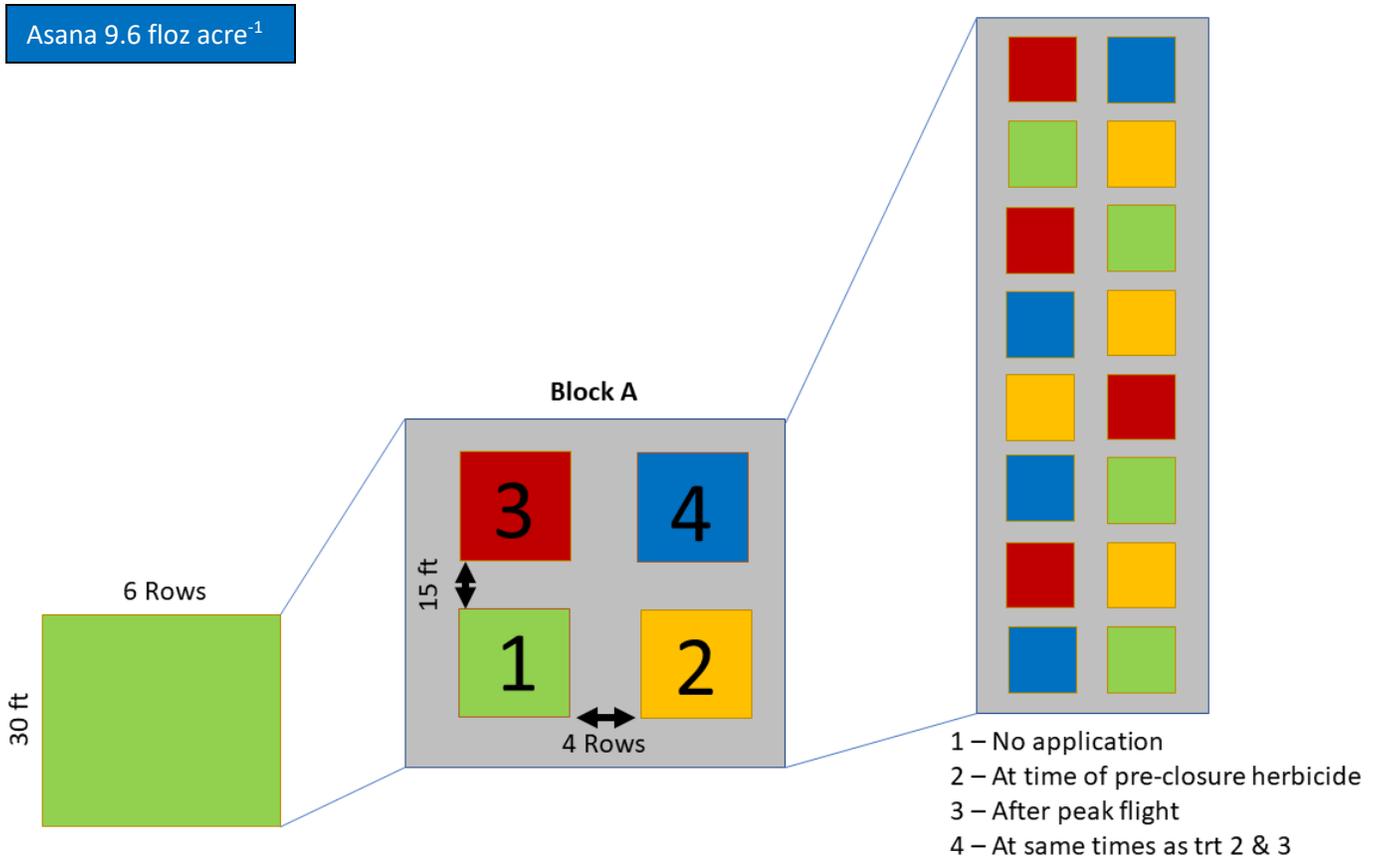


Fig. 8. Insecticide study plot map example | Photo Credit: JD Cluever

Table 4. Sampling activities in insecticide study

Activity	Dates
Vacuum	3-Aug; 13-Aug; 24-Aug
Sweep (15-swings)	3-Aug; 13-Aug
Flower (10-fully opened flowers)*	3-Aug; 13-Aug
Yellow sticky Cards	4-Aug; 13-Aug; 24-Aug; 25-Aug

\* Fewer flowers were taken in some plots on 13-Aug due to a lack of 10 flowers

**Bean Damage Assessment:**

To assess the level of WBC feeding injury on a regional scale, we harvested 104.5” of beans from four “plots” in the survey fields. In this case, the samples were twenty rows apart within each “plot.” The plots were 20, 120, 220, and 320 feet from the edge of the field. To assess the level of WBC feeding injury in the insecticide study, we harvested 104.5 linear row inches from the second and fifth rows of each plot. See **table 3** for harvest dates.

A subsample of about 50 pods was selected to quantify the number of WBC damaged pods. The remainder of pods were machine threshed. Percent pick was determined by dividing the mass of WBC damaged seed by the mass of total seed and multiplying by one hundred.



**Fig. 9.** Pheromone longevity | Photo Credit: Google Earth

was laid out in a transect of ten milk jug traps (**Fig. 9**) in a randomized complete block design. Each trap was placed a minimum of 200' apart from others. Pheromone lures were the same as those used in the trapping network. These traps were checked daily from the 13th of July to the 13th of August (except for some weekends).

#### **Communication with stakeholders:**

We sent out reports to our stakeholders via email. These were sent out on a weekly basis from the 4<sup>th</sup> of July to the 6<sup>th</sup> of August.

## **Results and discussion:**

#### **Survey Fields:**

The Smart Traps may give some false positives from captured army cutworms if traps are placed during their flight period. However, these species have little to no temporal overlap, so the concern is minor. If one were to use the uncorrected figures from the camera "smart" traps, all of the fields would be at low risk (**Table 5**). However, the camera "smart" traps are incapable of capturing as many WBC as

#### **Corn Scouting:**

Cornfields near the Eighty, Mitchell 4N, and Scottsbluff 6N fields were scouted for WBC egg masses. At each field, twenty consecutive plants were checked for WBC egg masses at six locations.

#### **Corn Damage Assessment:**

To assess the level of WBC injury on corn, we took ten ears from six locations at the same fields that we scouted earlier in the season. Injury was measured in cm<sup>2</sup>.

#### **Pheromone Longevity study:**

An additional study was conducted at the Panhandle Research and Extension Center (PHREC) to assess the longevity of pheromone lures in the field. The two treatments were 1) lures changed every two weeks and 2) lures changed every four weeks. The study

other traps. So, we multiplied the number of WBC in the camera “smart” traps by 57.2385 to obtain an equivalence with the milk jug traps. Using this metric, nine fields were high risk, three were moderate, and five were low (**Table 6**).

**Table 5.** Average cumulative catches of western bean cutworm in camera “smart” traps.

Field	Peak*	4-Jul	9-Jul	16-Jul	25-Jul	1-Aug	Cum. at peak	Risk
Bayard 6N	24-Jul	0.0	1.0	3.8	25.5	45.3	25.5	Low
Eighty	24-Jul	3.0	9.5	21.0	35.5	56.5	35.0	Low
Gering 2.5SE	24-Jul	0.0	4.0	11.5	25.5	37.5	25.0	Low
Gering 5SE	24-Jul	0.7	2.3	9.6	23.1	37.1	22.8	Low
Grant 5N	20-Jul	0.0	1.0	5.0	16.5	17.5	15.0	Low
Holyoke 2SE	21-Jul	1.5	2.0	8.0	9.3	18.8	9.0	Low
Imperial 6.5W	20-Jul	0.0	2.3	5.0	5.8	10.8	5.8	Low
Lamar 3.5W	21-Jul	1.0	1.8	4.5	5.0	5.0	5.0	Low
Lingle 5W	29-Jul	0.3	0.7	5.7	16.3	26.7	26.0	Low
Mitchell 3NE	24-Jul	0.0	0.8	12.8	26.5	39.8	26.5	Low
Mitchell 4N	24-Jul	0.0	1.5	7.0	16.0	26.0	15.5	Low
Morrill 3E	24-Jul	0.0	1.5	10.8	22.5	39.3	22.5	Low
Paxton 9.5 SW	19-Jul	0.0	0.3	5.0	20.0	24.8	5.67	Low
Ralston 6.5E	5-Aug	0.0	0.0	0.0	0.3	1.0	2.5	Low
Scottsbluff 1.5 NE	24-Jul	0.5	5.0	14.0	25.0	41.3	24.8	Low
Scottsbluff 6N	24-Jul	0.0	1.0	6.0	14.5	40.0	14.5	Low
Scottsbluff 6W	24-Jul	0.0	0.25	7.5	28.0	41.3	27.8	Low

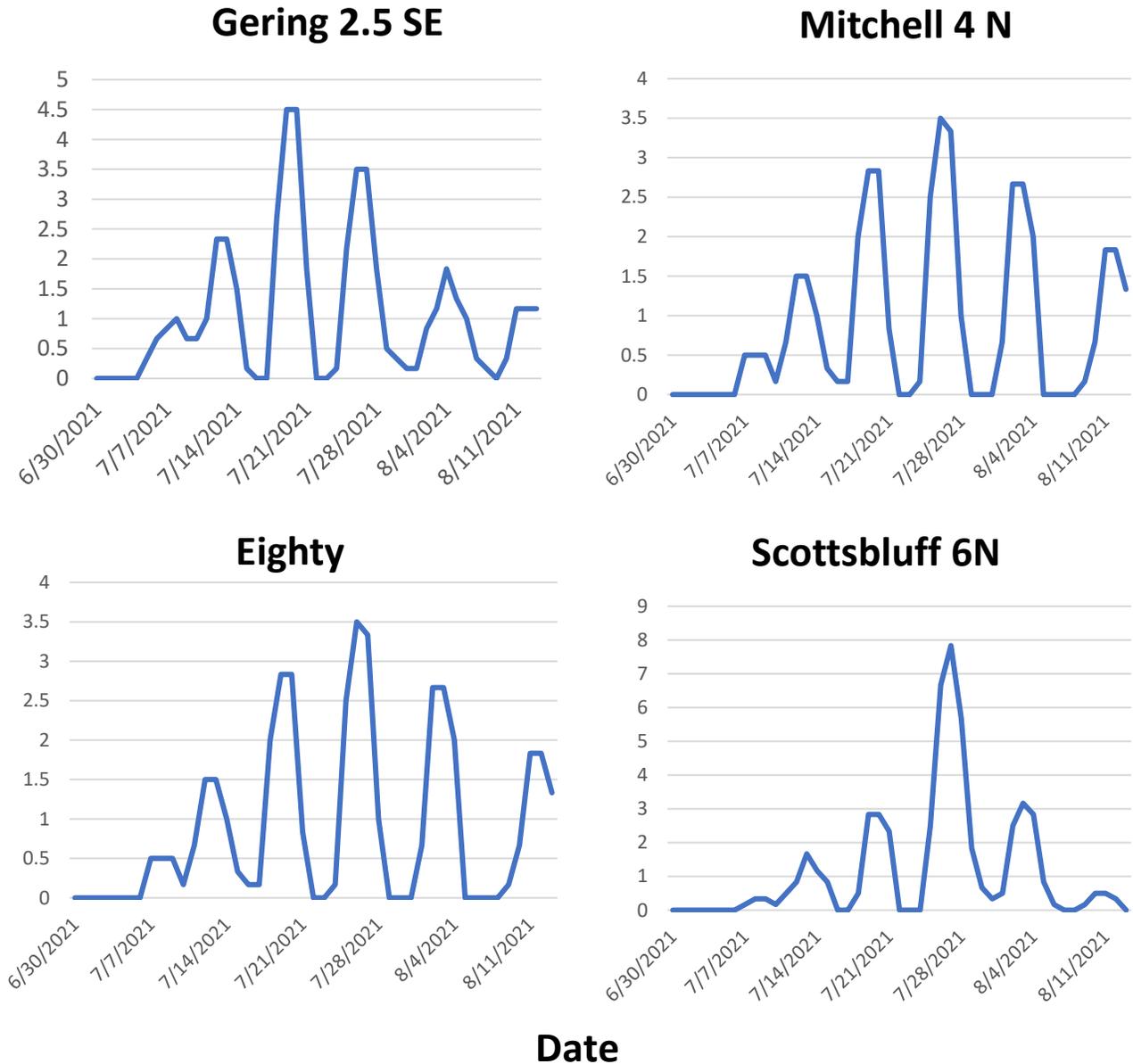
\*According to Degree-days by Cluever et al., 2001

**Table 6.** Corrected average cumulative catches of western bean cutworm in camera “smart” traps.

Correction made by multiplying # of WBC in smart traps by 57.2385

Field	Peak*	4-Jul	9-Jul	16-Jul	25-Jul	1-Aug	Cum. at peak	Risk
Bayard 6N	24-Jul	0.0	57.2	214.6	1459.6	2590.0	1445.3	High
Eighty	24-Jul	171.7	543.8	1202.0	2032.0	3234.0	2003.3	High
Gering 2.5SE	24-Jul	0.0	229.0	658.2	1459.6	2146.4	1431.0	High
Gering 5SE	24-Jul	38.2	133.6	548.5	1321.3	2122.6	1307.0	High
Grant 5N	20-Jul	0.0	57.2	286.2	944.4	1001.7	887.2	Mod.
Holyoke 2SE	21-Jul	85.9	114.5	457.9	529.5	1073.2	515.1	Low
Imperial 6.5W	20-Jul	0.0	128.8	286.2	329.1	615.3	329.1	Low
Lamar 3.5W	21-Jul	57.2	100.2	257.6	286.2	286.2	286.2	Low
Lingle 5W	29-Jul	19.1	38.2	324.4	934.9	1526.4	1488.2	High
Mitchell 3NE	24-Jul	0.0	42.9	729.8	1516.8	2275.2	1516.8	High
Mitchell 4N	24-Jul	0.0	85.9	400.7	915.8	1488.2	887.2	Mod.
Morrill 3E	24-Jul	0.0	85.9	615.3	1287.9	2246.6	1287.9	High
Paxton 9.5 SW	19-Jul	0.0	19.1	286.2	1144.8	1421.4	324.4	Low
Ralston 6.5E	5-Aug	0.0	0.0	0.0	14.3	57.2	143.1	Low
Scottsbluff 1.5 NE	24-Jul	28.6	286.2	801.3	1431.0	2361.1	1416.7	High
Scottsbluff 6N	24-Jul	0.0	57.2	343.4	830.0	2289.5	830.0	Mod.
Scottsbluff 6W	24-Jul	0.0	14.3	429.3	1602.7	2361.1	1588.4	High

\*According to Degree-days by Cluever et al., 2001



**Fig. 10.** 3-d rolling average camera “smart” trap catches *Note weekly peaks*

However, these results should be interpreted with caution for three reasons. 1) Several peaks were seen in the 3-day moving averages (**Fig. 10**). This is despite using a different sticky pad than in 2020. Thus, any future use of a similar trap must account for this effect. Accuracy may be improved by changing sticky pads more frequently (e.g. twice a week). 2) No sticky pad could possibly catch as many WBC as a milk jug, so a correction factor will always have to be used. 3) Efficacy is highly dependent upon regular maintenance.

**Trap type Comparison:**

The camera “smart” traps caught very few WBC compared to other traps (**Fig. 11**). Determining the occurrence of peak flight is not easily accomplished with camera “smart” traps.

The standard milk jug traps performed well. Definite peaks could be seen (**Fig. 12**). The primary drawbacks were their inability to hold as many moths as the green bucket traps, the time spent maintaining them, and their lack of durability to make it through the entire season.

The green bucket traps caught more moths than any other traps (**Table 5; Fig. 11**). Thus, greater resolution of WBC activity is possible (**Fig 13**). However, recommendations will need to be adjusted for this trap type.

Another key finding is that variance can be seen between the sides of the fields in terms of the time of peak (**Tables 8&9; Figs. 12&13**) and the cumulative number of moths at peak (**Tables 8&9; Fig. 14&15**). However, this effect is more marked in 2020 (**Figs. 16&17**). Take note that using different sides of the field may place it into different risk categories (**Table 8&9**). For instance, milk jug traps on the Gering 2.5SE field yield a low and moderate risk on sides B and A, respectively. This was more marked in 2020.

**Table 7.** Peak flight dates and cumulative WBC caught by trap type

Field	Trap	1 <sup>st</sup> capture	Peak	Diff (d)	Cum. WBC up to peak	Risk	Risk (Corrected)*
Gering 2.5SE	Smart <sup>+</sup>	6-Jul	24-Jul	18	25.0	Low	High
	Milk	7-Jul	21-Jul	14	796.5		Low
	Bucket	5-Jul	21-Jul	16	1197	High	Low
Mitchell 4N	Smart <sup>+</sup>	8-Jul	24-Jul	16	15.5	Low	Moderate
	Milk	30-Jun	21-Jul	21	1370		High
	Bucket	5-Jul	20-Jul	15	3010.5	High	High
Scottsbluff 6N	Smart <sup>+</sup>	8-Jul	24-Jul	16	14.5	Low	Moderate
	Milk	5-Jul	23-Jul	16	647		Low
	Bucket	5-Jul	22-Jul	15	588	Low	Low

<sup>+</sup> Peaks are not as definite as for the other traps, thus degree day models from Cluever et al., 2021 were used

\*corrected values are CR=smart\*57.2385 and CR=bucket\*0.39257

**Table 8.** Effect of side of field on WBC captures in Green bucket traps

Year	Field	Side A		Side B	
		Peak	Cumulative	Peak	Cumulative
2021	Gering 2.5SE	20-Jul	1169	21-Jul	1197
	Mitchell 4N	20-Jul	1582	22-Jul	3207
	Scottsbluff 6N	22-Jul	1704	22-Jul	1113
2020	Canal	21-Jul	1251	23-Jul	132
	Hill	23-Jul (top)	1076	24-Jul (bot)	2395
	Mitchell N	29-Jul (CR A)	588	23-Jul (Cook)	1882

**Table 9.** Effect of side of field on WBC captures in a Milk jug traps

Year	Field	Side A		Side B	
		Peak	Cumulative	Peak	Cumulative
2021	Gering 2.5SE	21-Jul	988	21-Jul	605
	Mitchell 4N	21-Jul	1308	22-Jul	1696
	Scottsbluff 6N	19-Jul	502	23-Jul	647
2020	Canal	23-Jul	567	23-Jul	319
	Hill	24-Jul (top)	516	22-Jul (bot)	867
	Mitchell N	23-Jul (CR A)	366	27-Jul (Cook)	1658

**Bean damage ratings:**

Damage varied across the study area. The number of pods with holes ranged from zero to about eight percent. The percent pick ranged from zero to 0.4 percent. Note that WBC damage can be scattered throughout the field. Thus, some samples may have or be free from damage purely by chance.

No statistical differences were found among the insecticide treatments for the percent of pods with holes (**Fig. 18**). However, the percent pick was higher in the no and pre-closure applications (**Fig. 19**). The results were similar in 2020.

The Gering 2.5SE field had a higher proportion of injured pods (**Fig. 20**) and also had a higher percent pick (**Fig. 21**). In the survey fields, the Scottsbluff 1.5 NE field had a higher proportion of injured pods (**Fig. 22**) and a higher percent pick (**Fig. 23**).

In the study fields, the peak dates for each trap type within the field we determined using the 3-day rolling averages. The plots (in the study fields) with no insecticide application were used for the bean damage assessments. It was hard to determine a peak for the camera “smart” trap captures, so the peak was determined by the number of degree-days accumulated (Cluever et al., 2021).

Interestingly, the camera “smart” traps in compare/insecticide fields had the highest R-squared values (**Table 10**). All trap types had low R-squared values, especially the smart traps in the survey fields. This is likely due the many zeros in the dataset. Several equations had negative slopes, which is unlikely to reflect reality. Additionally, none of the slopes are statistically different from zero except for the equation predicting percent pick form smart trap captures in the compare/insecticide fields. These results are likely due to the complex interaction between the WBC flight and crop phenology that cannot be explained by the limited nature of our dataset. It is necessary for an in-depth study on this topic.

**Table 10.** Equations for the correlation between the number of WBC caught and crop damage

Metric	Field Type	Trap Type	Equation	R <sup>2</sup>	P-value
% Pick	Survey (incl. Eighty)	Smart <sup>+</sup>	$Y_s = -0.094 + 0.00035X$	0.0000	0.9644
	Compare/insect	Smart <sup>+</sup>	$Y_s = -0.858 + 0.05943X$	0.2333	0.0196
	Compare/insect	Milk	$Y_s = 0.730 - 0.00052X$	0.0666	0.2343
	Compare/insect	Bucket	$Y_s = 0.420 - 0.00012X$	0.0389	0.3668
% of pods with injury	Survey (incl. Eighty)	Smart <sup>+</sup>	$Y_p = -1.120 + 0.02098X$	0.0002	0.9100
	Compare/insect	Smart <sup>+</sup>	$Y_p = -3.367 + 0.29201X$	0.0872	0.1613
	Compare/insect	Milk	$Y_p = 6.815 - 0.00493X$	0.085	0.1657
	Compare/insect	Bucket	$Y_p = 4.238 - 0.00131X$	0.0680	0.2184

\*Difficult to determine peak, Degree days as in Cluever et al., 2021 was used (24-Jul)

X is the number of moths caught up to peak flight

Y<sub>p</sub> is the percent of pods with holes

Y<sub>s</sub> is the percent of WBC damaged seed by weight

The relationship between milk and green bucket traps is  $Y_m = 117.565 + 0.395X_b$ . This equation has an R<sup>2</sup> of 0.7259 and a P-value of <0.0001. Where Y<sub>m</sub> is the number of moths caught in a milk jug trap up to peak flight, and X<sub>b</sub> is the number of moths caught in a bucket trap up to peak flight.

The relationship between milk and camera “smart” traps is  $Y_m = 31.035 + 57.239X_s$ . This equation has an  $R^2$  of 0.4939 and a P-value of  $<0.0001$ . Where  $Y_m$  is the number of moths caught in a milk jug trap up to peak flight, and  $X_s$  is the number of moths caught in a camera “smart” trap until peak flight.

**Corn Scouting:**

The number of plants with egg masses was 5.8, 12.5, and 6.7 percent at Mitchell 4N, Scottsbluff 6N, and Eighty, respectively. These surpass the four percent threshold recommended if corn is \$3.50/Bu (Wright et al., 2021).

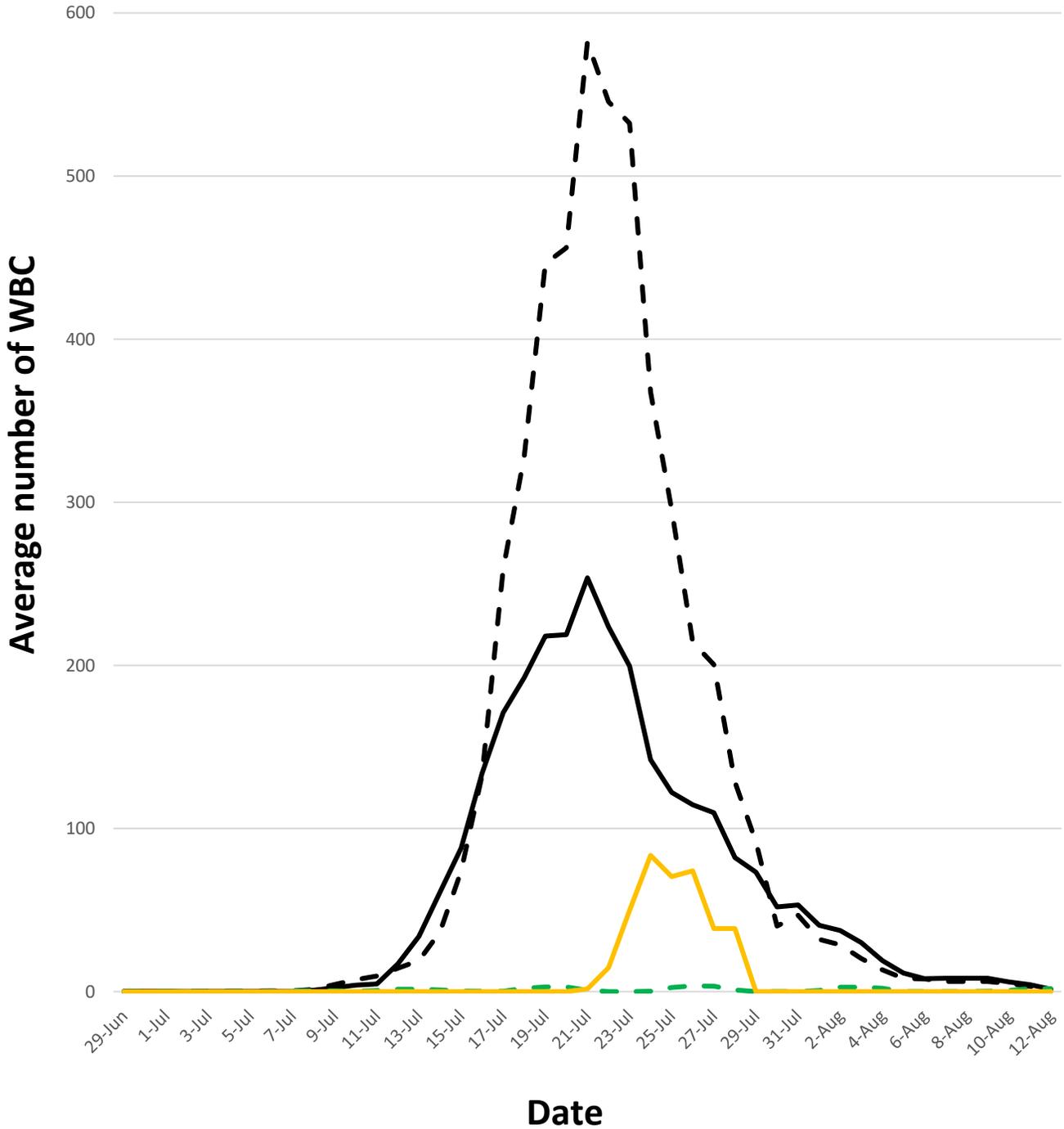
**Corn Damage rating:**

Most of the injury to corn ears was at the tips. The average injury was 9.2, 7.2, and 3.1 cm<sup>2</sup> per ear for the fields near Eighty, Scottsbluff 6N, and Mitchell 4N, respectively.

**Pheromone longevity:**

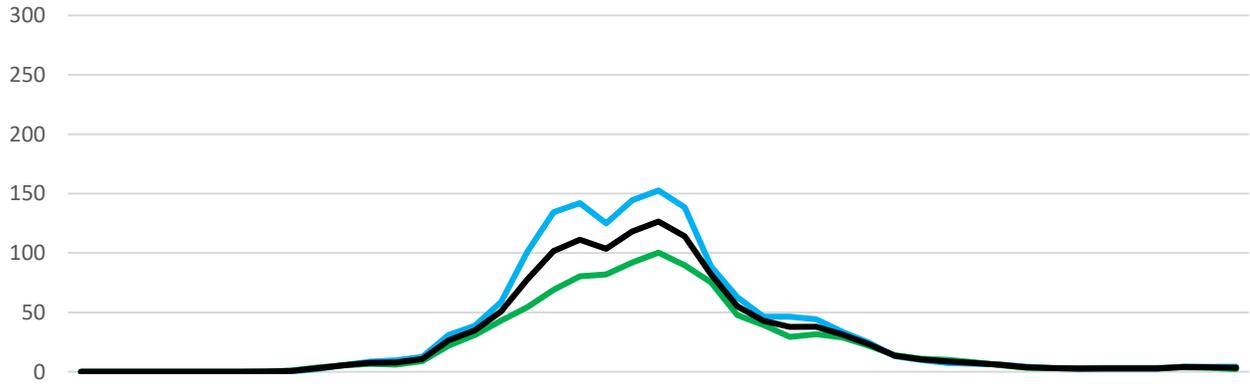
The traps where the pheromone was changed every four weeks captured a greater number of moths (**Fig. 24**). This is in contrast to the findings in 2020 (**Fig. 25**). However, the number of moths caught up to peak did not differ significantly (**Fig. 26**), nor did the days to peak. More study is needed with different trap types and locations. However, if the results are consistent, then money could be saved on the pheromone. Currently, pheromone costs \$1.75/ lure.

### 3-d avg comparison of traps

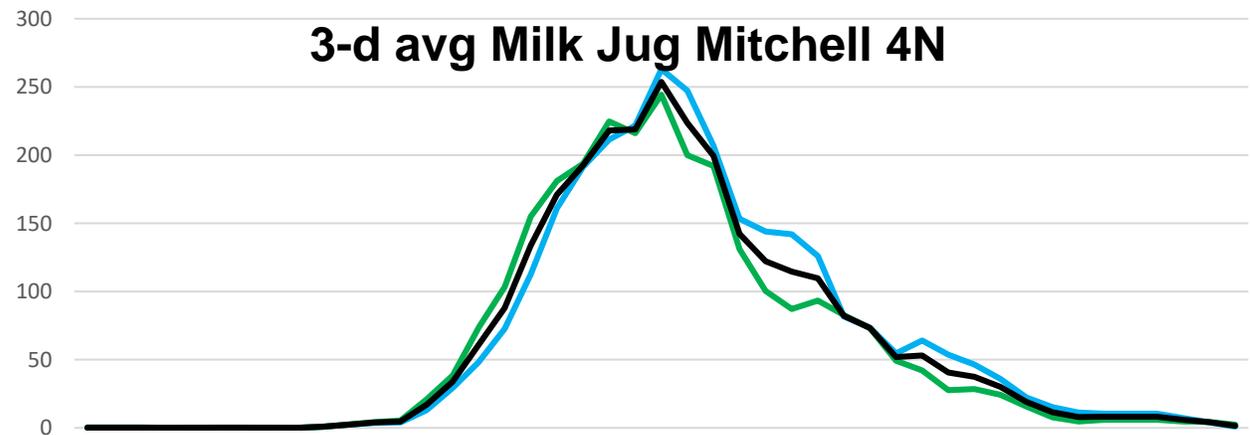


**Fig. 11.** 3-day average comparison of traps at Mitchell 4N (2021)| Dashed black = Green bucket; Solid Black = Milk; Dashed green = Camera “smart” trap; Solid Yellow = Gering manual *note that zeros early in the season are artificial because trap not deployed until later*

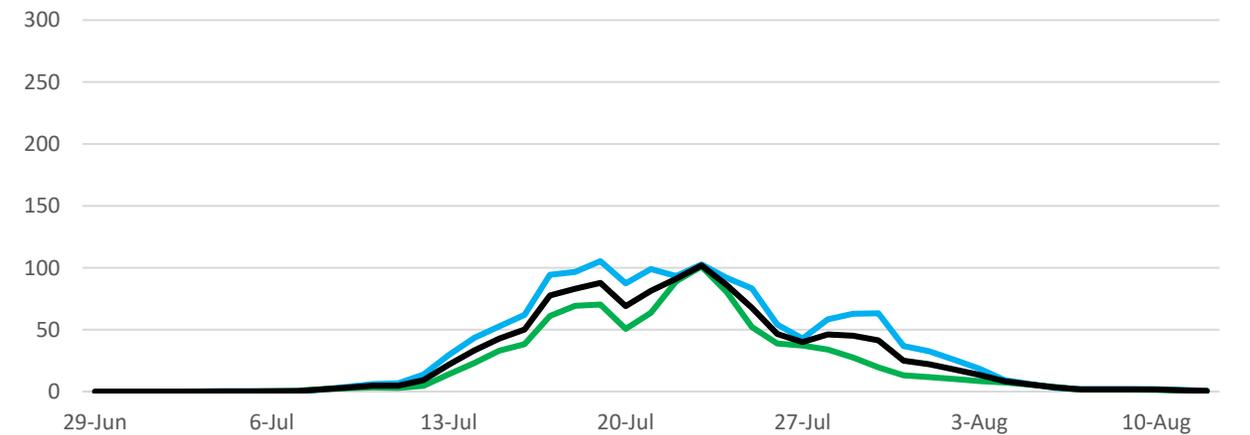
### 3-d avg Milk Jug Gering 2.5SE



### 3-d avg Milk Jug Mitchell 4N



### 3-d avg Milk Jug Scottsbluff 6N



Average number of WBC

Date

Fig. 12. 3-day average for milk jug catches (2021)| Blue = Side A; Green = Side B; Black = Average

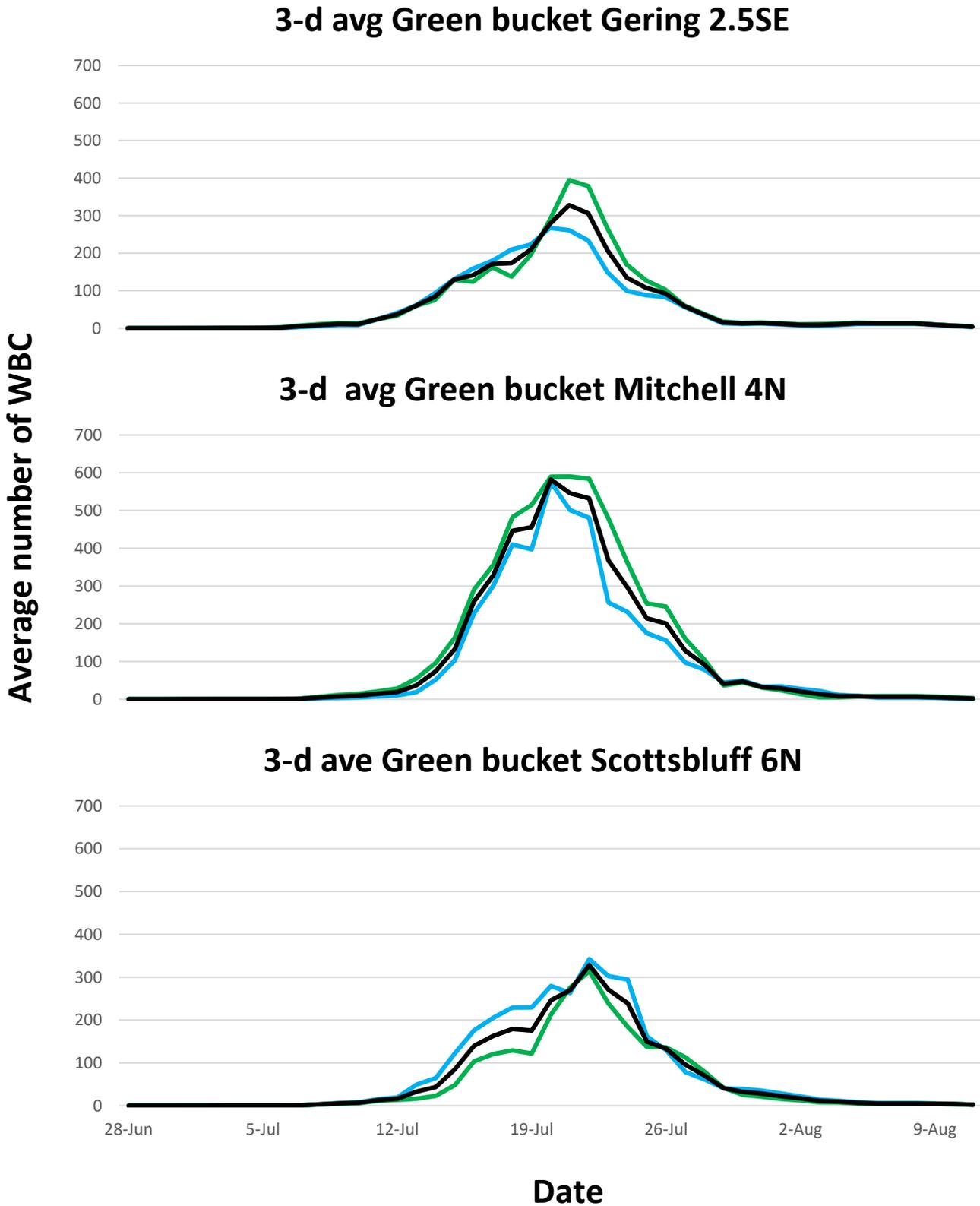
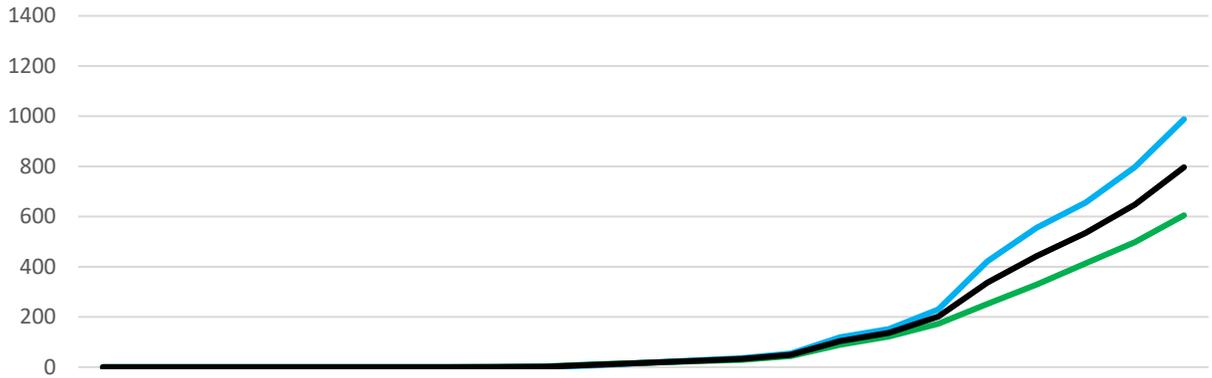
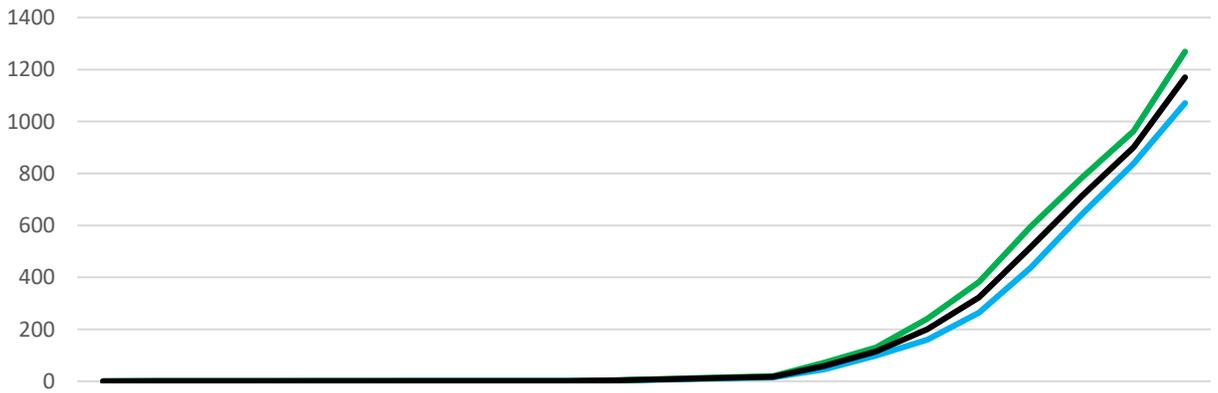


Fig. 13. 3-day average for green bucket catches (2021)| Blue = Side A; Green = Side B; Black = Average

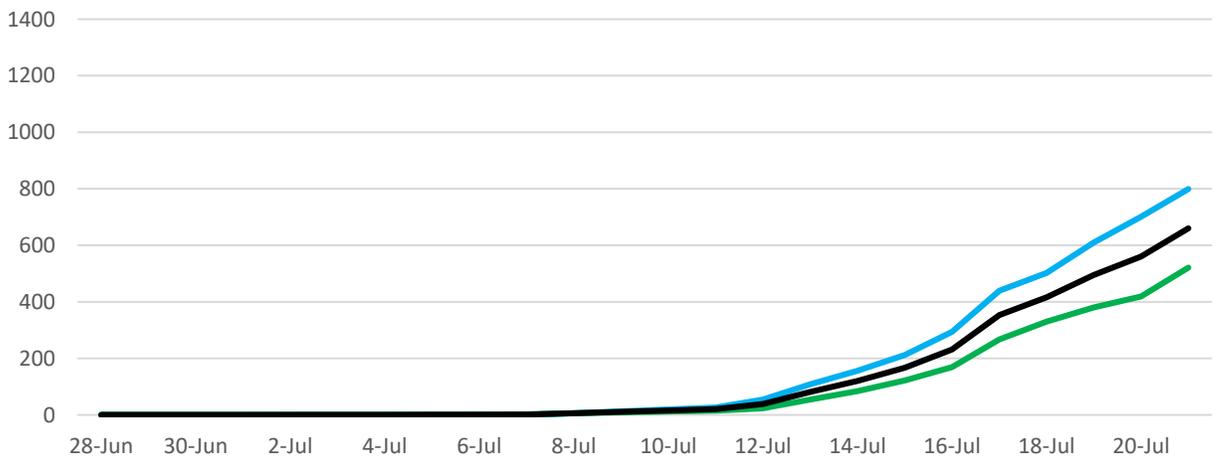
### Cum. milk jug Gering 2.5 SE



### Cum. milk jug Mitchell 4N



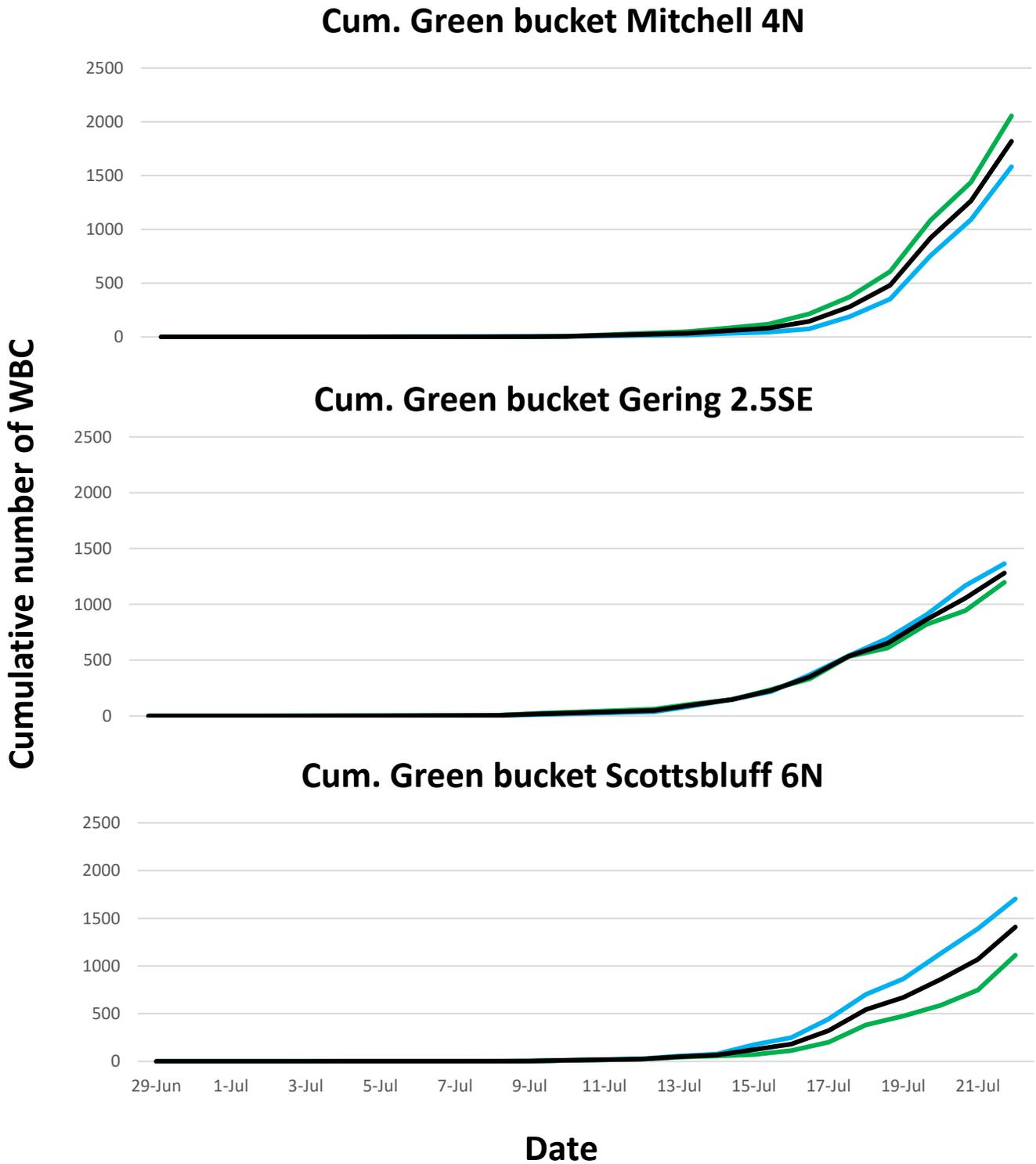
### Cum. milk jug Scottsbluff 6N



Cumulative number of WBC

Date

Fig. 14. Cumulative catches for Milk jug until peak (2021) | Blue = Side A; Green = Side B; Black = Average



**Fig. 15.** Cumulative catches for green bucket until peak flight (2021)| Blue = Side A; Green = Side B; Black = Average

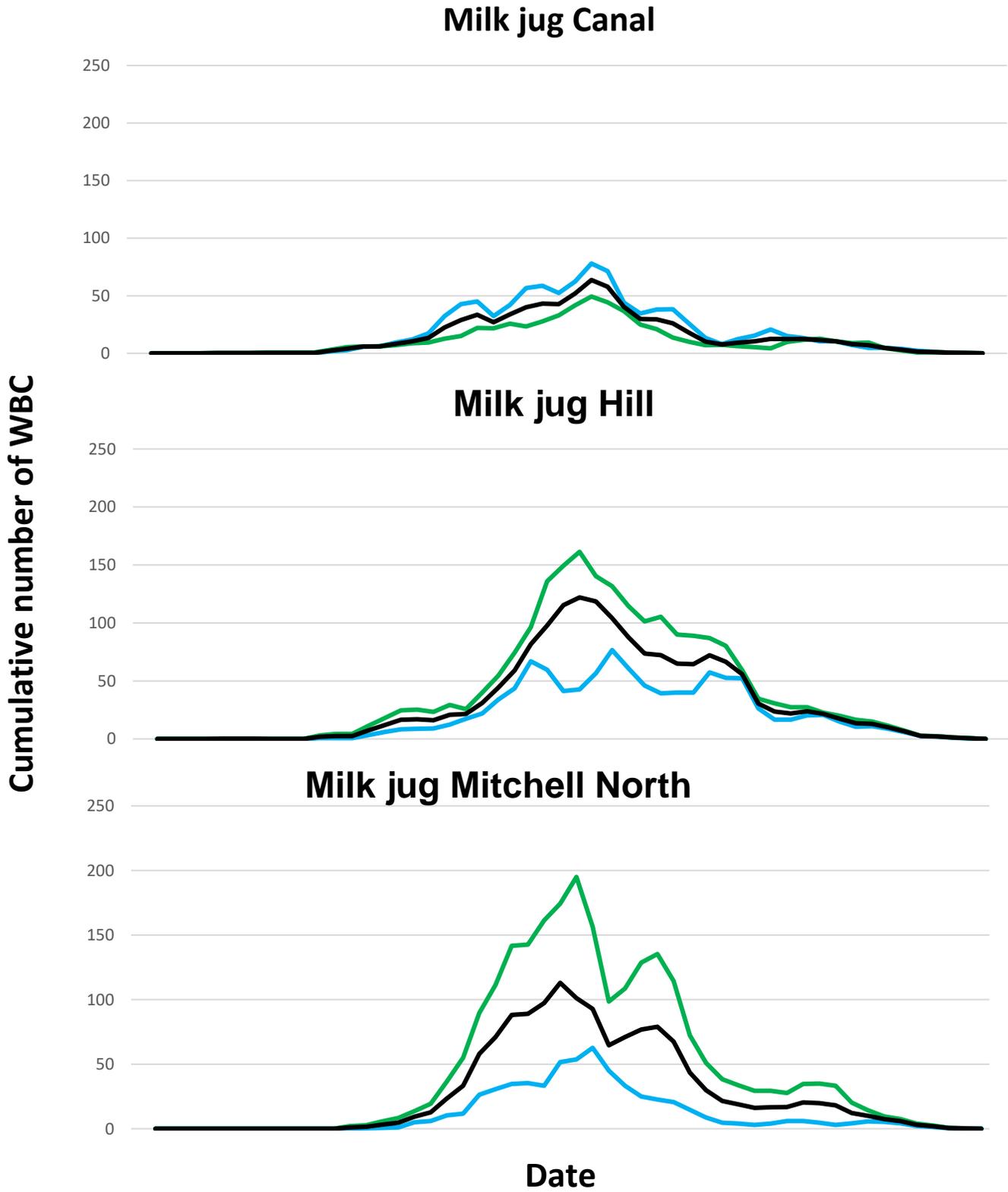
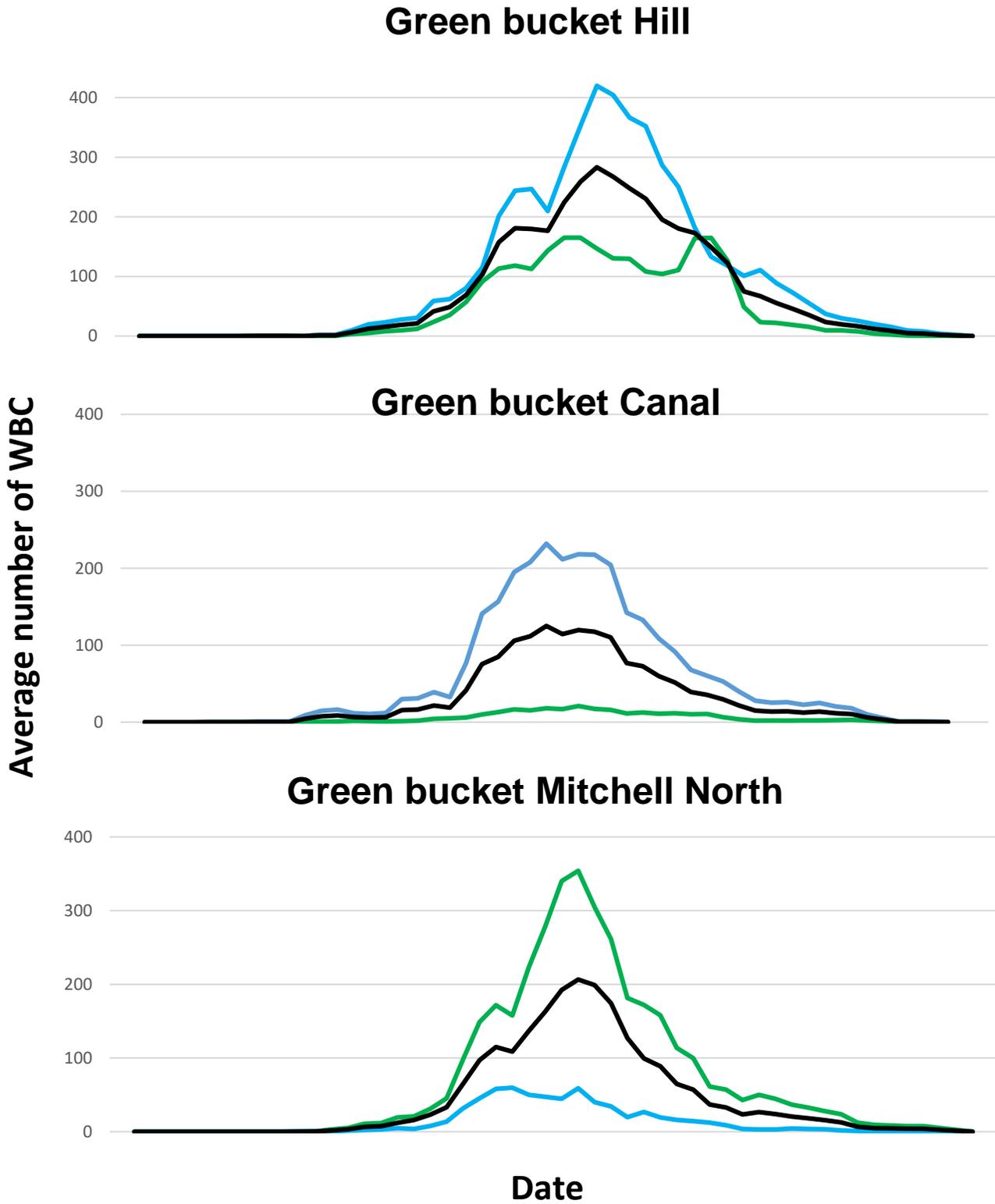


Fig. 16. 3-day average for Milk jug catches (2020) | Blue = Side A; Green = Side B; Black = Average



**Fig. 17.** 3-day average for green bucket trap catches (2020) | Blue = Side A; Green = Side B; Black = Average

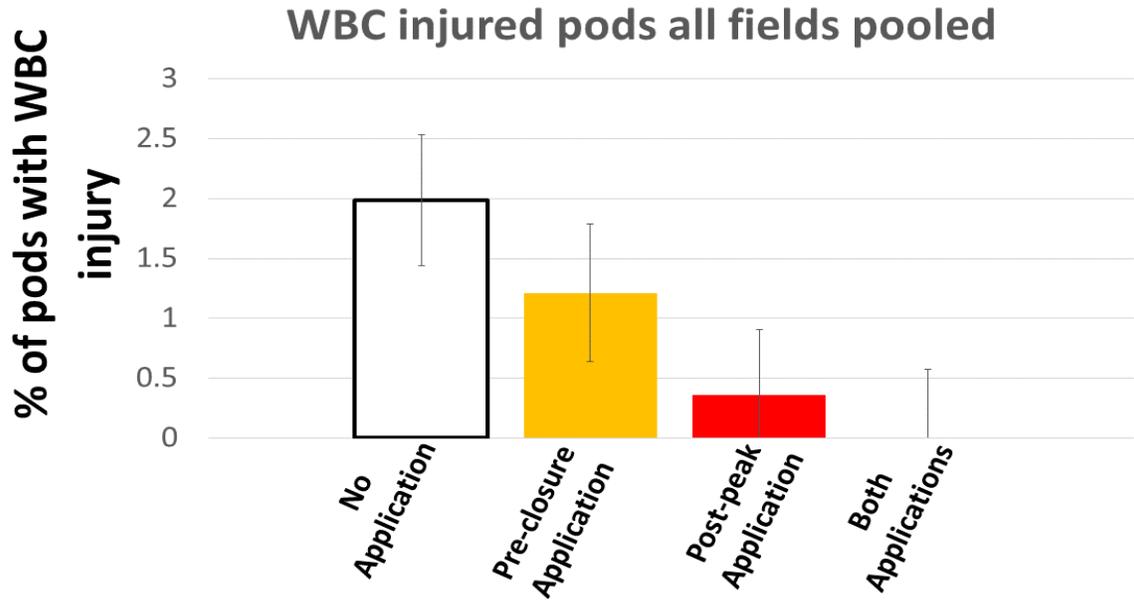


Fig. 18. Effect of insecticide on percent of WBC injured pods (No significant differences)

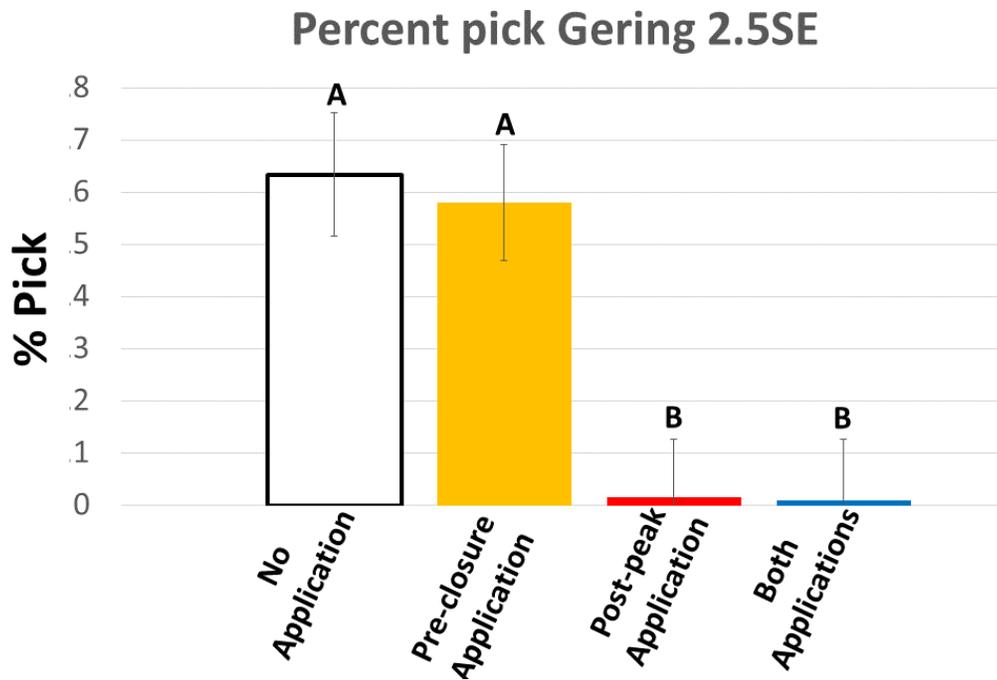


Fig. 19. Effect of Insecticide on percent pick (Gering 2.5 SE Field)

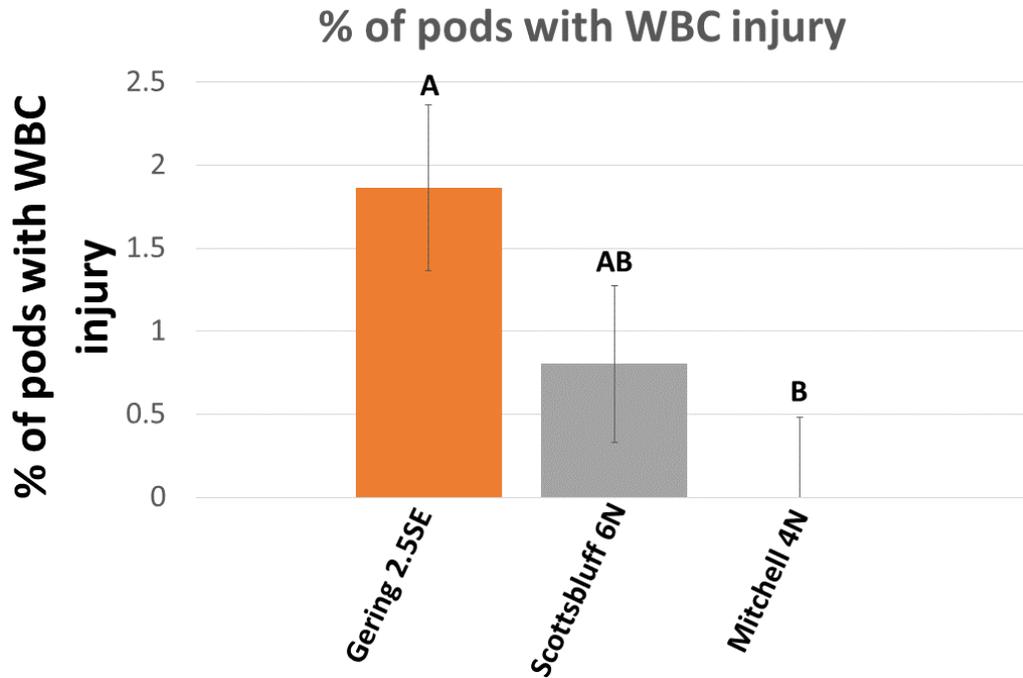


Fig. 20. Effect of field on percent of WBC injured pods

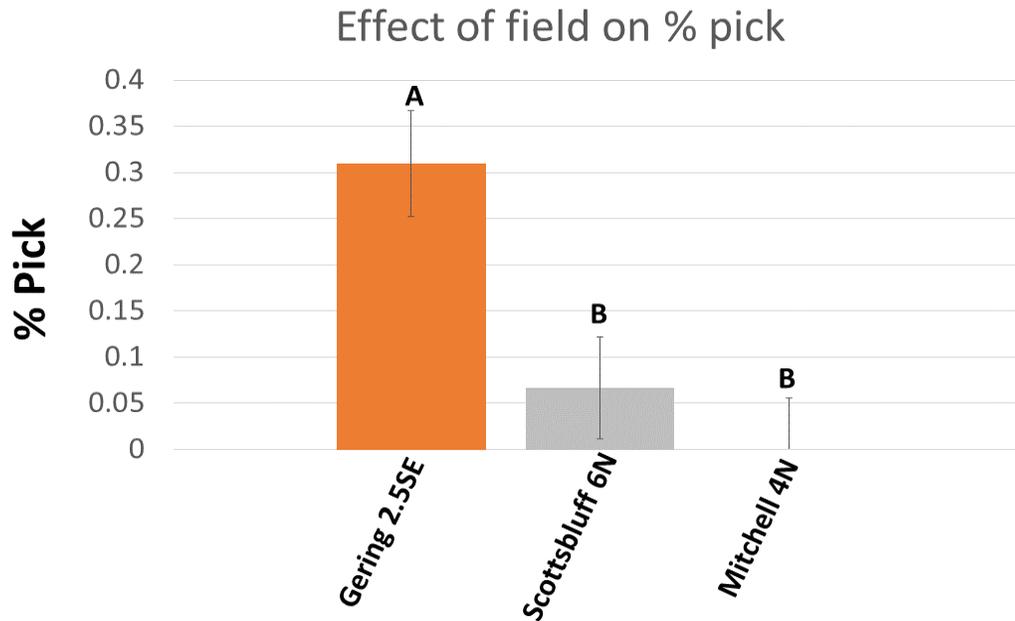
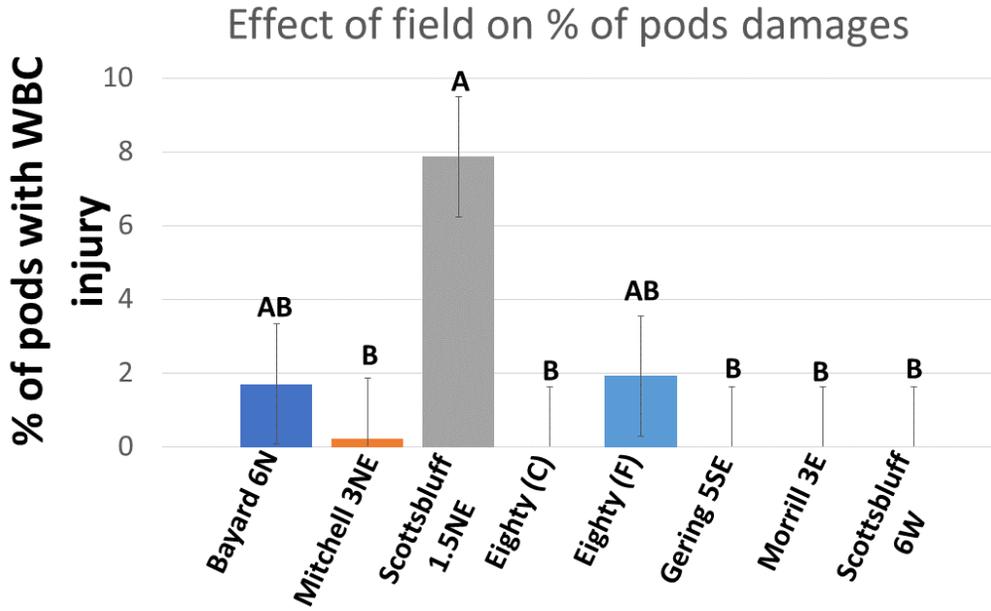
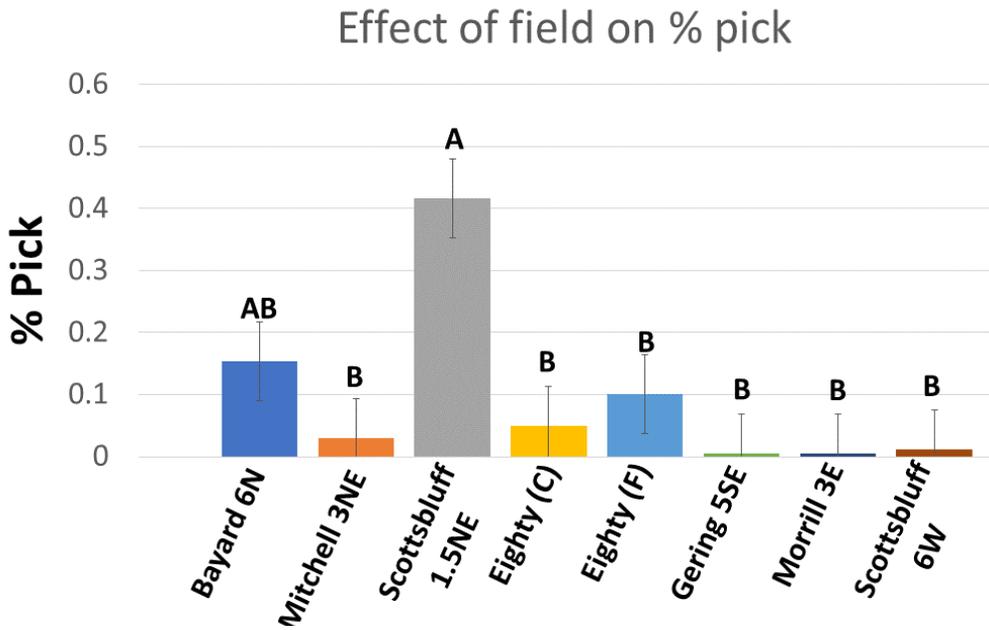


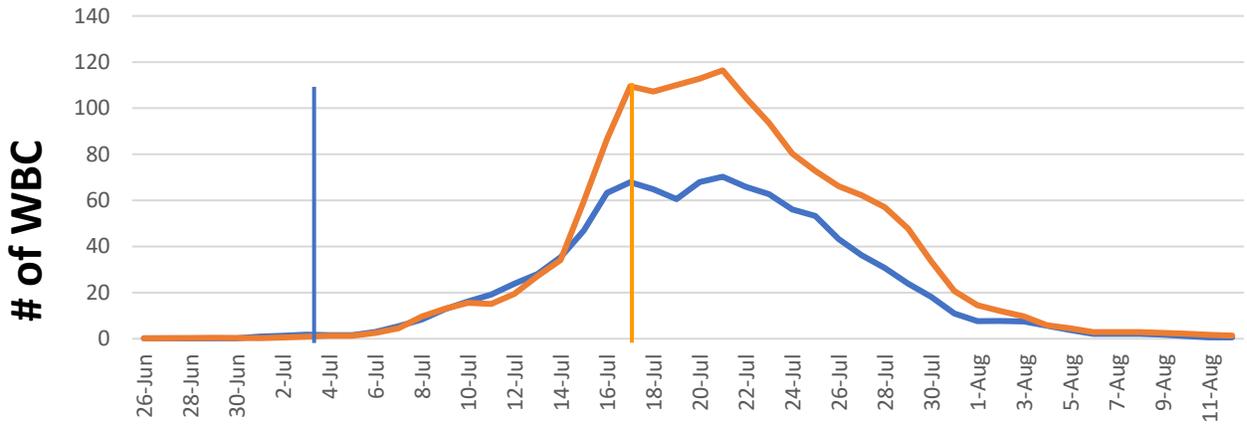
Fig. 21. Effect of field on percent pick



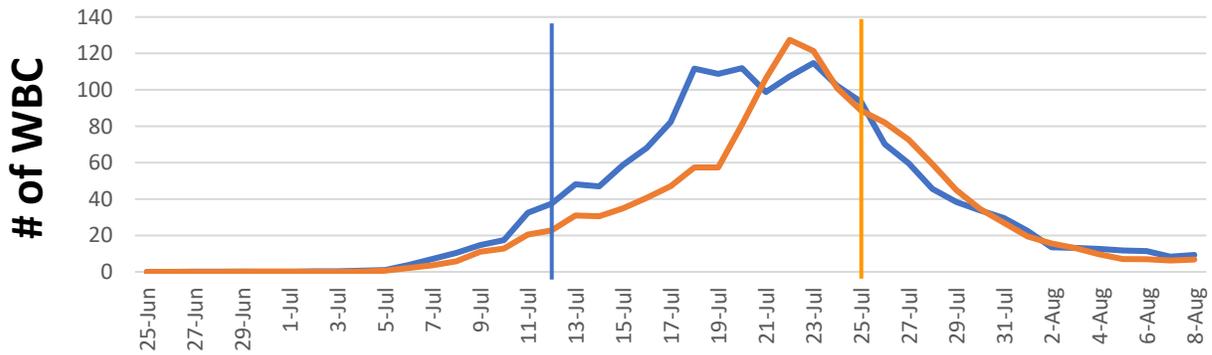
**Fig. 22.** Effect of survey field on percent of WBC injured pods Eighty (C) = near corn; Eighty (F) = away from corn



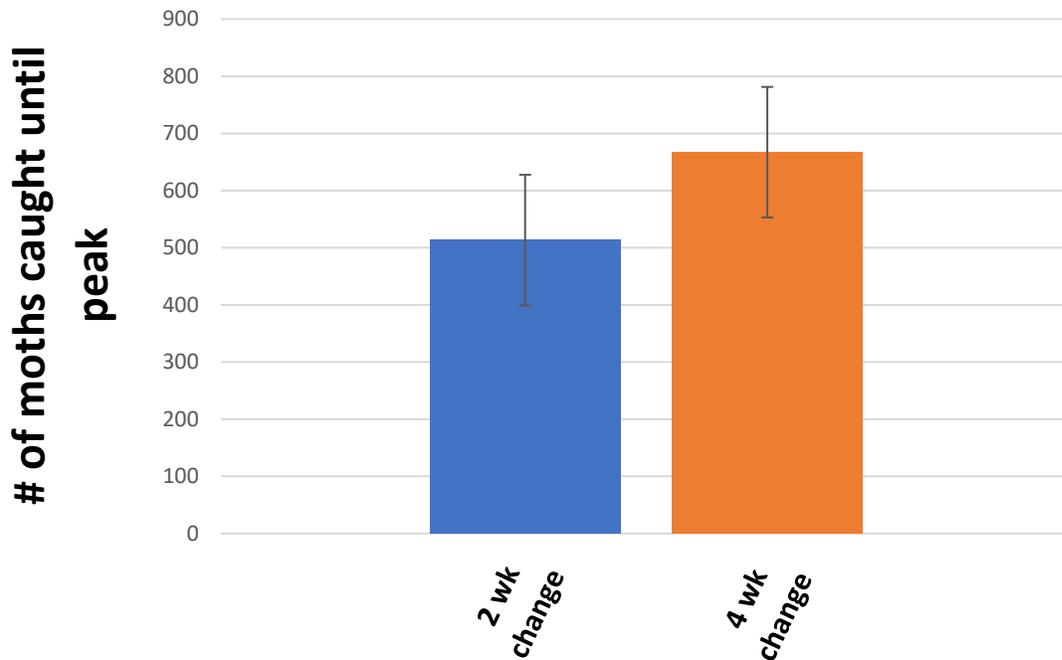
**Fig. 23.** Effect of survey field on percent pick Eighty (C) = near corn; Eighty (F) = away from corn



**Fig. 24.** Effect of pheromone change frequency on WBC catches (2021) | Blue = changed every 2 wk; Orange = changed every 4 wk; vertical blue = date when changed in 2 wk trt; vertical orange = date when changed in 2 & 4 wk trt



**Fig. 25.** Effect of pheromone change frequency on WBC catches (2020) | Blue = changed every 2 wk; Orange = changed every 4 wk; vertical blue = date when changed in 2 wk trt; vertical orange = date when changed in 2 & 4 wk trt



**Fig. 26.** Effect of pheromone change frequency on # of WBC caught up to peak (No significant differences)

**References:**

Cluever, J., J. Peterson, R. Wright, and J. Bradshaw. 2021. Degree-days for prediction of western bean cutworm flight. Crop Watch: Institute of Agriculture and Natural Resources. University of Nebraska-Lincoln. <https://cropwatch.unl.edu/2021/degree-days-prediction-western-bean-cutworm-flight>.

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