ANNUAL REPORT

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TITLE: Determine management strategies to minimize seed yield loss in spring canola due to flea beetle infestation.

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ACCOMPLISHMENTS:

Materials and Methods. A third year of this study was grown near Moscow, Idaho during the summer of 2020 to supplement data gathered from duplicate trials grown in 2018 and 2019. The study evaluated two different flea beetle management regimes: (1) Helix® Vibrance® seed treatment (23 fl. oz. per 100 lbs. of seed) only; and (2) Helix® Vibrance® seed treatment plus a foliar insecticide spray [Warrior II with Zeon Technology® (lambda-cyhalothrin) at 1.9 fl. oz. per acre] with 0.125% v/v R56 adjuvant.

In each year of the study, the plots were seeded in a conventionally tilled field where a spring barley crop had been grown the previous year. The fields were chisel plowed in the previous fall and then lightly cultivated in the spring prior to seeding. A dry blend of urea and ammonium phosphate-sulfate fertilizers (31-10-0-7) was applied and incorporated to the soil at 300 lbs. per acre to supply 90 lbs. of nitrogen per acre. Trifluralin herbicide was applied and incorporated before seeding to control broadleaf weeds and wild oats.

Four spring canola/rapeseed cultivars (*Brassica napus*) with differing maturities and an Indian mustard (*B. juncea*) were used in the study. The *B. napus* cultivars used were 'Industrious', a very early industrial rapeseed; 'HyCLASS 930 RR' canola (now marketed as CP930RR); 'Star 402 RR' canola; and 'DynaGro 200', a late maturing canola cultivar. The Indian mustard cultivar used was 'Pacific Gold' and was included in the trial because *B. juncea* is known to be especially attractive to flea beetles. Seeding rates were determined for each cultivar based on 1000-seed weight to achieve approximately 12 seed per square foot.

Each cultivar-flea beetle treatment combination was seeded at three different dates at two-week intervals. The seeding dates were April 25, May 1, and April 28; May 8, May14, and May 14; and May 23, May 28, and May 28 in 2018, 2019, and 2020, respectively. At each seeding date, the plots were arranged into replicated blocks for foliar insecticide application, where half the blocks would receive the foliar insecticide, and half would not receive a foliar insecticide. Plot size was 5 x 15 feet, and trial had four replications.

After seedling emergence, all plots were monitored regularly for flea beetle damage to determine the appropriate time to a apply the foliar insecticide. When damage reach approximately 15% defoliation, the foliar insecticide was applied to the treatment blocks as described above. In some cases, the seeding date blocks were sprayed on different dates depending on the amount of flea damage present in each block. Approximately one week after spraying, each plot was visually evaluated for flea beetle feeding damage on a scale of 1 to 9 where 9 represents no damage and 1 represents complete defoliation. Flowering dates for each were recorded when plants reached 50% bloom, and plant canopy heights were measured at crop maturity. Plots were harvested when ripe with a small plot combine. Plots were monitored for pod shatter losses, but no shatter losses were observed over the course of the experiment. The harvested seed was dried to a uniform moisture content and weighed. A subsample of seed from each plot was taken to determine oil content using an NMR analyzer.

Results. During all three years of the study, flea beetle pressure was relatively low to moderate, with an average damage rating of 7.2 (on a scale of 1 to 9, with 9 being no visible damage). Flea beetle damage in 2019 (score of 8.2) was less than that in 2018 (score of 7.0), and it was most severe in 2020, with a score of 6.4 Averaged across all years and all planting dates, Pacific Gold showed the most flea beetle damage with a rating of 6.7, and DynaGro 200 showed the least damage with a score of 7.6 (Table 1). Days from seeding to 50% flowering ranged from 43 days for Pacific Gold to 51 days for DynaGro 200. Average seed yield of the cultivars varied from 1,639 lbs. per acre for Industrious to 2,019 lbs. per acre for HyCLASS 930, with a trial mean of 1,840 lbs. per acre (Table 1).

Table 1. Average flea beetle damage score (scale of 1 to 9 with 9 being no damage), days from seeding to 50% flowering, and seed yield of five cultivars grown near Moscow, Idaho in 2018, 2019 and 2020.

Cultivars	Flea Beetle Damage (1 to 9 score)	Days to 50% Flower	Seed Yield (lbs./acre)
Pacific Gold Mustard	6.7 [a]	42 [a]	1,774 [b]
Industrious Rapeseed	7.1 [b]	44 [b]	1,639 [a]
HyCLASS 930 RR	7.3 [b]	46 [c]	2,019 [c]
Star 402 RR	7.4 [c]	47 [d]	1,976 [c]
DynaGro 200 CL	7.6 [c]	51 [e]	1,791 [b]
Mean	7.2	46	1840
LSD (p=0.05)	0.2	0.2	92

Means within columns with different superscript letters are significantly different ($P<0.05$)

In general, flea beetle feeding damage on the seedlings was most severe in the mid-May seeding dates and the least severe for the latest seeding date. This is demonstrated by examining the mean flea beetle scores from all three years of the study (Table 2). The intermediate date had the lowest score 7.0, which indicates the most damage. The early seeding date had a mean score of 7.2, and early seeding reduced flea beetle damage in two of the three years. The late seeding date had a score of 7.5. By the time the late-seeded plants had emerged, flea beetle populations were likely declining, but in this study the yield reduction caused by other factors associated with late seeding far outweighed any reduction in flea beetle pressure.

Seed yield was significantly and dramatically affected by seeding date. In 2018, the early seeding date had the highest yield, 2,837 lbs. per acre, and each two-week delay in seeding time resulted in approximately a 30% yield reduction. Yields were lower in 2019 than in 2018, and the early and intermediate seeding dates had similar yields of 1,738 and 1,703 lbs. per acre, respectively. The late seeding date in 2019 (May 28) produced only 734 lbs. per acre.

In 2020, the data followed a similar trend to the first year with each delayed seeding date yielding less than previous one with yield for the early, intermediate, and late seeding dates being 2,837, 2,153, and 1,132 lbs. per acre, respectively. When results from the three years were combined, the seed yield from the three seeding dates, early to late, was 2,470, 1,964, and 1,086 lbs. per acre, and delaying seeding until late May resulted in a 56% yield loss (Table 2) compared to the earliest seeding date. Seed oil content was not reduced by the first two-week delay in seeding time, but it was reduced in the third seeding date (Table 2.) A seeding date by cultivar interaction was seen with both seed yield and oil content, where the seed yield and oil content of DynaGro 200, the late cultivar, was reduced more by the delayed seeding date than that of the other cultivars.

Table 2. Average flea beetle damage score (scale of 1 to 9 with 9 being no damage), seed yield (lbs. per acre), and oil content (%) of five canola, rapeseed, and mustard cultivars with three seeding dates when grown near Moscow, Idaho in 2018, 2019 and 2020.

Seeding Dates	Flea Beetle Damage (1-9 score)	Seed Yield (lbs./acre)	Oil Content (percent)
Early	7.2 [b]	2,470 [a]	42.9 [a]
Intermediate	7.0 [a]	1,964 [b]	42.2 [a]
Late	7.5 [c]	1,086 [c]	39.7 [b]
LSD (p=0.05)	0.2	186	1.0

Means within columns with different superscript letters are significantly different (P<0.05)

An examination of flowering data suggests two reasons for the yield decrease seen with the later seeding dates (Table 3). With each two-week delay in seeding time, the time of flowering was delayed 10 to 11 days. This pushed flowering and seed filling to a time later in the summer with higher temperatures and lower relative humidity, which would increase the environmental stress on the crop. In addition, the time from seeding to flowering decreased as seeding was delayed (Table 3). This likely reduced the amount of above and below ground vegetative growth of the crop prior to flowering. A five-inch reduction in plant canopy height from the early to the late seeding shows the reduced growth. This means that in addition to the seed fill period occurring in a more stressful environment, the plants were smaller and could not produce the same resources for seed set.

As mentioned above, the statistical analysis of the data showed a significant interaction between seeding date and cultivar for seed yield. An interaction often indicates a change in ranking of one factor when examined at different levels of another factor. This was the case in this study, were the latest flowering cultivar, DynaGro 200, dropped from the third best yield in the first two seeding dates, to the fifth position in the third date, while Pacific Gold, the earliest cultivar, moved from the fourth rank in the first two seeding dates to the second best yield in the third seeding date. This suggests that late flowering, long-season cultivars could be even more sensitive to delayed seeding dates than other cultivars.

Table 3. Mean flower date, days from seeding to 50% flowering, and plant canopy height of five canola, rapeseed, and mustard cultivars with three seeding dates when grown near Moscow, Idaho in 2018, 2019, and 2020.

Seeding Dates	50% Flower Date	Days to 50% Flower	Plant Height (inches)
Early	June 17 [a]	51 [a]	44 [a]
Intermediate	June 27 [b]	45 [b]	42 [b]
Late	July 8 [c]	43 [c]	39 [c]
LSD (p=0.05)	0.3	0.3	1.8

Means within columns with different superscript letters are significantly different (*P*<0.05)

The effect of a foliar insecticide spray varied across planting dates and years, but averaged across all three years of the study, a foliar insecticide spray improved flea beetle damage score from 6.9 to 7.5. Seed yield improved from 1,734 lbs. per acre to 1,946 lbs. per acre, a difference of 212 lbs. (Table 4). The greatest difference in yield due to insecticide spray treatment was seen at the intermediate seeding date in 2020 when spraying a foliar insecticide increased yield by 492 lbs. per acre from 1,907 to 2,398 lbs. per acre. Over the three years of the study, not spraying delayed flowering by a half day, a statistically significant difference, but probably not a practical difference. Seedling stands and seed oil content were not affected by the insecticidal spray treatment, and this data is not presented.

Table 4. Average flea beetle damage score (scale of 1 to 9 with 9 being no damage) and seed yield (lbs. per acre) on sprayed and unsprayed blocks of five canola, rapeseed, and mustard cultivars with three seeding dates when grown near Moscow, Idaho in 2018, 2019 and 2020.

Seeding Dates	Flea Beetle Damage (1-9 score)	Seed Yield (lbs./acre)
Not Sprayed	6.9 [a]	1,734 [a]
Sprayed	7.5 [b]	1,946 [b]
LSD (p=0.05)	0.1	127

Means within columns with different superscript letters are significantly different (*P*<0.05)

PROJECTIONS: This planting date-foliar insecticide study showed that early seeding or delayed seeding resulted in a slight decrease in flea damage, likely due to avoiding the peak populations of flea beetles during the early seedling stage, but any positive effect of delayed seeding was far out-weighed by yield losses associated with delayed seeding. (Note that optimum seeding times will vary from region to region as will the peak for flea beetle activity. In addition, seeding too early into cold soils and when the chance of killing frost is high should be avoided.)

The study also showed that even with fairly low flea beetle pressure, a foliar application of insecticide can be justified and will increase seed yields of spring canola. At a canola price of 17 cents per pound, the seed yield increase of 212 lbs. per acre observed in the trial has a value of $36 per acre. This should be more than enough to cover the cost of insecticide and application. With more flea beetle damage, such as the situation seen for the intermediate planting date in 2020, the economic return would be greater, as much $83 per acre in this example. Canola prices are currently over 20 cents per pound in the Inland PNW, which would provide an even higher return on a foliar spray.

These studies show that moderate flea beetle infestation can reduce yield even when insecticidal seed treatments are used. More intensive management with foliar insecticides has the potential to improve yields and economic returns, especially if higher farmgate prices for canola prevail. Further research to determine more precise thresholds and optimum timing for foliar insecticide applications will help canola growers realize the advantages of more intensive management strategies. In addition, a new seed treatment option, Lumiderm (cyantraniprole), is beginning to be applied to spring canola seed sold in the U.S., and additional work should be undertaken to determine how it interacts with foliar sprays.

PUBLICATIONS AND OUTREACH:

Davis Jim B., Ashley Job, Megan Wingerson, and Jack Brown. 2020. Impact of Flea Beetle Damage, Insecticide Application, and Delayed Seeding Dates in Spring Brassica Crops *in* 2020 Field Day Abstracts. Washington State University, Oregon State University, University of Idaho.

Davis, Jim B., Ashley Job, and Jack Brown. 2020. University of Idaho Canola Update. Northern Idaho Cereal Schools presentation. Greencreek, Idaho, Lewiston, Idaho, and Bonners Ferry, Idaho. January 21, 22, 23, 2020.

Davis, Jim B., Jonah Kaya, and Jack Brown. 2021. University of Idaho Canola Update. Northern Idaho Cereal Schools online presentation. January 27, 2021.

Davis, Jim B., Kayla Yearout, Jonah Kaya, Kurt Schroeder and Jack Brown. 2021. University of Idaho Canola Update. PNW Canola Association Workshop online presentation. February 10, 2021.