Tolerance Variation to Mexican Bean Beetles of Common Bean Cultivars FNE03-457

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Goals

The goals of the project were to test the tolerance of different bean cultivars to Mexican Bean beetle and find varieties that produce well under intense pressure from this insect. The varieties that were tested were several commercially important beans, they were as follows: 'Provider,' 'Bush Blue Lake,' 'Royal Burgundy,' 'Dragon Tongue,' 'Soldier Bean/Maine Yellow Eye,' and 'Vermont Cranberry'. The overall experimental set up was a randomized block design. Twenty individuals of each bean type were planted in five blocks for a total of 100 individuals per variety and 600 individuals for the whole project. Leaf damage was assessed mid-growing season and dry beans were counted and weighed for 5 individuals of each variety per block, 25 total per variety, 150 individuals overall for the project. The weights and counts of beans were analyzed using an ANOVA.

The analysis has just been finished, public outreach will occur at the Connecticut Northeast Organic Farming (CT-NOFA) meeting on March 6th, in CT-NOFA publication "Gleanings", and also personal communication with Kim Stoner my technical advisor at the CT Agricultural experiment station and the University of Connecticut vegetable specialist.

Farm Profile

Our farm is a small mixed operation, we use about 2 acres of land. We are part-time farmers. We raise pasture fed rare breed chickens and turkeys for meat and eggs and sell them locally. We are also starting a small dairy goatherd. Seeds and vegetable are also a large part of our operation. We grow heirloom and open pollinated seeds of several crops such as corn, beans, sorghum, tomatoes, squash, peppers, peas etc., and have sold them in the local food co-op, through the mail, and trade them with members of the Seed Savers Exchange.

Participants

Kimberly Stoner Entomologist at the Connecticut Agricultural experiment station was the technical advisor for the project, and helped develop damage assessment methods and informed us of the Mexican bean beetles behavior and life cycle.

Diane Dorfer assisted in weeding, thinning, harvesting, and data collection for the project.

Project Activities

The project was carried out according to the proposal with a few minor adjustments. Due to availability problems two beans were substituted, "Bush Blue Lake" took the place of "Tender Lake", and "Vermont cranberry" replaced "Jacob Cattle beans", the substituted varieties are similar in use and other general characteristics to the originally proposed cultivars. Twelve hundred beans were planted on June 4th 2003. The bean beetle appeared on June 30th. The plants were thinned to 600 plants on July 15th. Leaf damage data was collected on Aug 8th which was rated on a 1-4 scale, 1 = 0-25% damage, 2 = 26-50%, 3=51-75% and 4 = 76-100%. It was noted that almost total defoliation had occurred by Aug 19th, and the beans plants were harvested and hung to dry on Sept 1st. Bean shelling occurred in November, number and weight data was recorded in December. Data analysis was also done in December. The number of bean pods was not recorded because it was difficult to determine what a pod was since several small wither pods occurred that did not contain any viable seeds.

One major difference from our planned methods was we did not move the eggs masses because they were hatching by the time they were noticed. The Mexican bean beetle and eggs did not appear in large number until late in the season. We had been observing the plants during the expected emergence time but saw very few beetles and we assumed we were in a low infestation year, we later realized that they were just delayed due to the wet cool spring weather and laid eggs when we weren't watching and larvae were emerging by the time we saw them. Because of the block design we were able to sort out different levels of infestation in parts of the plot.

Results

Key to abbreviations: Maine Yellow Eye = mye, Vermont Cranberry = vtc, Provider = pr, Bush Blue Lake = bb, Royal Burgundy = ryb, Dragon tongue = dt.

Based on an ANOVA with leaf damage as a co-variable to variety we found a significant statistical difference between the weight of Dragon tongue bean and the other cultivars, the mean in grams/plant for the varieties were: mye 5.66g, vtc 5.48g, pr 4.72g, bb 4.24g, ryb 3.44g, dt 2.90g (Table 1). Statically mye, vtc, pr, bb, ryb showed no significant differences from each other. With damage taken out as the co-variable, the variety yield weights were also significant different most likely due to genetic differences that cause one cultivar to be more productive than another, Dragon tongue was again the least productive. The variety alone also effected the number of beans per plant, the mean yield in number of beans/plant was vtc 22, pr 20.6, bb 18.24, ryb 16.64, mye 15.9, dt 13.5 (Table 1). Variety combined with damage did not significantly affect the number of beans. The position or blocks within the plot also had significant effects on the yield, block 5 was furthest (see map) from the over wintering sites for the bean beetle meaning it suffered less damage and had the highest yield for number and weight. The mean counts/plant were block 5 21.4 beans/plant, block 3 18.8, block1 29, block 4 16.4, block 2 14.4. The mean weights in grams/plant for the blocks were block 5 5.53g, block 3 4.53g, block 1 4.31g, block 4 3.96g, block 2 3.8g (Table 1).

Table 1.

Variety w/damage	Variety Alone Weight g	Variety Alone count	Block count	Block weight g
Mye 5.66 a	Mye 5.66 a	Vtc 22.00 a	5 21.43 a	5 5.53 a
Vtc 5.48 ab	Vtc 5.48 a	Pr 20.68 a	3 18.76ab	3 4.53 ab
Pr 4.72 ab	Pr 4.72 ab	Bb 18.24 ab	1 18.34ab	1 4.31 ab
Bb 4.24 ab	Bb 4.24 abc	Ryb 16.64 ab	4 16.4 ab	4 3.96 b
Ryb 3.44 ab	Ryb 3.44 bc	Mye 15.95 ab	2 14.48 b	2 3.8 b
Dt 2.9 b	Dt 2.9 c	Dt 13.5 b		

Means with the same letter are not significantly different

In short the variety and the amount of leaf damage effected the weight of beans harvested, variety alone predicted the number of beans, and the variety did not predict the amount of damage done to the leaf. Vermont Cranberry and Maine Yellow eye yielded the best in weight. This was unexpected because in our previous experience Royal Burgundy seemed to do better than most cultivars at out farm. Maine Yellow eye and Vermont Cranberry may not be any more tolerant to the Mexican Bean beetle but they may mature faster or allocate more of their resources to the beans resulting in a higher yield. The results with bean number and damage together showed no significant difference, it seems that the insect damage decreases the size and weight of the beans but did not effect the number produced. In heavily damaged areas we did note visually the high number small beans.

Conditions

This spring was cool and wet the weather delayed the emergence and egg laying of the beetle. The beans may have had more time to grow than usual before an infestation occurred. In addition, there was a great deal of rain this year, perhaps the foliage was more palatable to insects because of the additional precipitation and some cultivars may have performed better with high moisture.

Economics

Our bean trial taught us that Maine Yellow eye and Vermont Cranberry are good varieties to grow for selling seed. They are not green beans for fresh eating but they yield well, and were of high quality not having many imperfections and had little mold. In addition, they are easily shelled.

Assessment

We have thought of several new ideas to try. From the standpoint of growing fresh beans for market we are developing a strategy where we could do a one time harvest of beans instead of a continual harvest. This is because the bean plants die in late August from the bean beetle pressure, we hope to find a green bean variety with a single large flush of uniform maturing pods, after this flush we hope to plant a fall crop. This year after the bean were harvested the plot was fallow we realized that the premature death of the bean plants caused by the beetles is the perfect timing because it makes room for fall greens and other late cool season crops. We actually planted garlic in part of the experimental plot because we thought it would grow well from the added nitrogen fixed by the beans. We are also hoping to plant seeds from the highest yielding individuals of Maine Yellow eye and Vermont Cranberry to see if we can select for plant that yield well under high bean beetle pressure. We also noted that Vermont Cranberry had several out-crossed seeds. Bean usually self pollinate and produce uniform beans from generation to generation but occasionally some will be pollinated by neighboring cultivars to give new combinations, Vermont Cranberry had a few out-crosses in it and we may grow these to see if the new combination yield better than the parent variety.

Adoption

We will continue to grow Maine Yellow eye and Vermont Cranberry for seed because we feel they perform well enough even with a great deal of bean beetle damage.

Outreach

Public outreach is in progress we will post out results in a display at the Connecticut Northeast Organic Farming (CT-NOFA) meeting on March 6th. In CT-NOFA publication "Gleanings" we will write a short article about what we found. We will ask out technical advisor Kim Stoner at the CT Agricultural experiment station to tell other growers about what we found if it is appropriate to their situation, and we will send

a copy of our results to the University of Connecticut vegetable specialist and our local extension agent.

Block Map for Mexican Bean Beetle Experiment
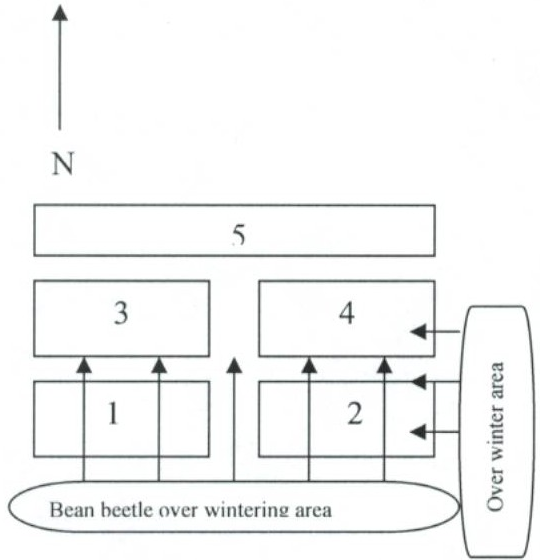
→ = Direction of bean beetle movement

Each block contains 20 individuals each of all six bean varieties for a total of 120 bean plants per block.