RELATIONSHIP BETWEEN NITROGEN FERTILIZER RATE, ONION THRIPS AND YIELD IN NEW YORK

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Onion thrips, *Thrips tabaci*, is the primary insect pest on onions in New York. If onion thrips are not controlled, damage can routinely reduce bulb yields by 30-50%. Bulb weight can be reduced even further if plants are infected with *Iris yellow spot virus* (IYSV), a virus that is transmitted between onion plants by onion thrips. Insecticides are the principal control methods used to manage onion thrips in onions, but registration and label requirements on newer insecticides may limit the use of each product to two consecutive applications per season; a single product will not be available for use over the entire 6-8 week growing season.

Preliminary studies showed that onion plots receiving lower rates of applied nitrogen fertilizer had similar yields as plots receiving higher amounts of nitrogen (N), but onion thrips populations were significantly lower in the plots receiving less nitrogen. Cultural practices, like reducing N, that could either delay the colonization of onions by thrips, and thus delay when insecticide use began, and/or reduce the reproduction rate or survival of thrips over time, and eliminate the need for one or two sprays over the season, could ensure that the limited number of insecticide products available to growers would last over the whole season. Cornell University currently recommends 125 lbs N/acre for onions grown in muck soils. We tested the impact of the recommended amount and 5 other rates of N fertilizer on onion thrips populations and bulb yield in field trials in 2010.

Materials & Methods

Trials were conducted in two separate fields planted with 'Red Bull' onion seed. Soil samples taken prior to planting to determine how much N to add to the treatment plots to bring each plot up to the target N level. Each field was divided into 6 blocks, and each block was further separated into 6 treatment plots, one for each of the N treatments (2, 62, 74, 94, 125, 187 lbs N/acre). Treatment plots were 40 ft long by 4 rows wide. Nitrogen was applied three times: at pre-plant 75% of the total was applied as calcium nitrate (15.5-0-0); 2 lbs/acre was applied as starter nitrogen at planting; and a second application of calcium nitrate was applied one month post-planting. Each treatment plot was split in half; one half was sprayed routinely with insecticides (Movento or Radiant) once thrips reached a 3 thrips/leaf threshold, and the other half received no insecticides. Fungicides were applied to the entire test site.

Soil samples were taken 5 times over the season to estimate the amount of soil nitrate over time in the treatment plots. Plant tissue samples were taken twice to estimate plant nitrate levels early and late in the season. Larval and adults thrips were counted in each half of every plot 9 times over the season, and insecticides were applied 5 times. All bulbs were harvested in each half plot, graded and weighed. A subset of bulbs were placed in cold storage to estimate bacterial rot after storage. Final yields will be calculated after stored bulbs are graded for rot. Preliminary results from one of the two fields are presented below.

Results

There were significant differences in soil nitrate levels between the 6 N treatments; plots receiving the highest levels of N fertilizer maintained the highest levels of mean soil nitrate between 25 May and 14 July (**Fig. 1**). There were also significant differences in the amount of N in onion leaves (**Fig. 2**); onion plants in the higher N treatment plots had significantly more N in their leaves.

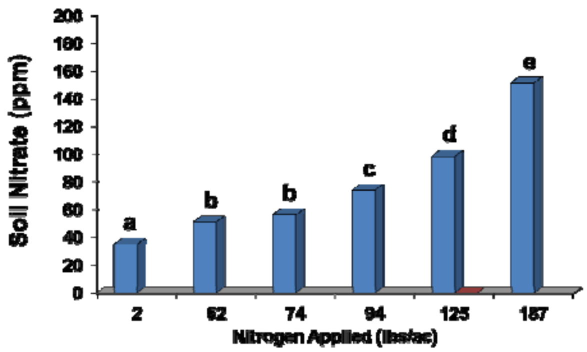

Figure 1. Mean soil nitrate concentrations in the six treatment plots between 25 May and 14 July, 2010. Columns with different letters are significantly different at $P < 0.05$

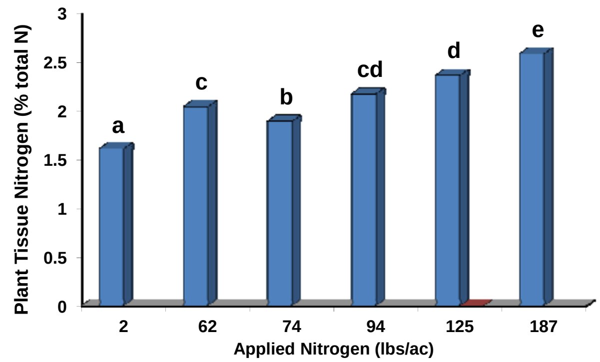

Figure 2. Average total nitrogen in onion plant tissues collected from the six treatment plots on 30 June, 2010. Columns with different letters are significantly different at $P < 0.05$

The mean number of larval onion thrips per plant averaged across the entire season was significantly higher in plots that received the greatest amounts of N fertilizer (**Fig. 3**). There were no significant differences in larval thrips densities between plots receiving 0, 62 and 74 lbs N/ac, and no differences in larval thrips densities between plots receiving 94, 125 and 187 lbs N/ac. Mean bulb weights for marketable-sized bulbs (bulbs > 2 inches in diameter) were significantly higher in treatment plots that received N fertilizer compared with plots that received only starter-N (**Fig. 4**). There were no significant differences in bulb weights between plots receiving 74-125 lbs N/ac. Plots receiving the highest N treatment, 187 lbs N/ac, had bulbs with a significantly greater mean weight.

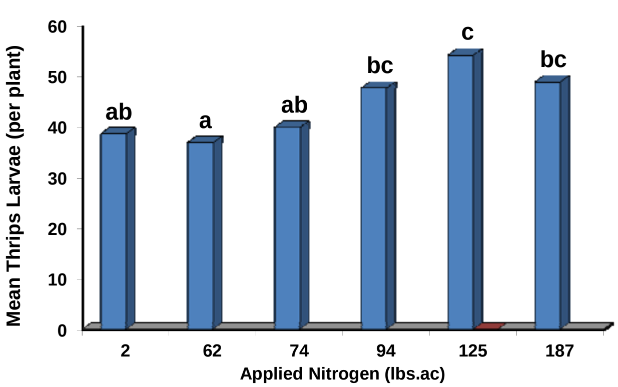

Figure 3. Mean number of larval onion thrips per plant. Plots that received the greatest amounts of N fertlizer had the greatest number of larval thrips. Columns with different letters are significantly different at $P < 0.05$

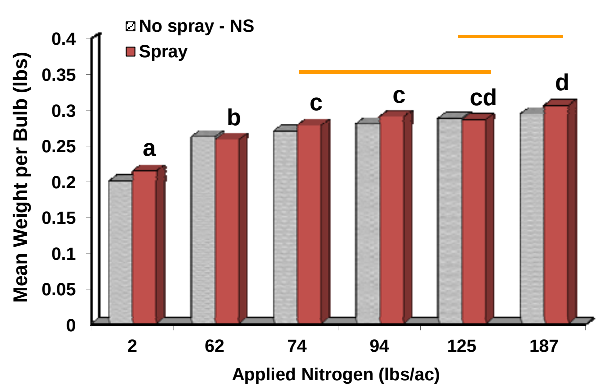

Figure 4. Plots were split in half, one half of the plot was sprayed with insecticide the other half received no sprays. There were no significant differences in mean bulb weights for the plot halves that did not receive any insecticide sprays; the plot halves that received sprays had significantly different bulb weights. Columns with different letters are significantly different at $P < 0.05$.

Unexpectedly, there were significantly higher levels of bacterial rot in marketable sized bulbs in all plots that received ≥ 62 lbs N/acre fertilizer compared with plots that received only 2 lbs N/acre (**Fig. 5**). There were no significant differences in the percentage of bulbs with rot between the plots that received calcium nitrate fertilizer. There was also a significant relationship between the amount of N applied and the percentage of plants that had lodged by 18 August; the more N applied, the greater the percentage of plants that lodged (**Fig. 6**).

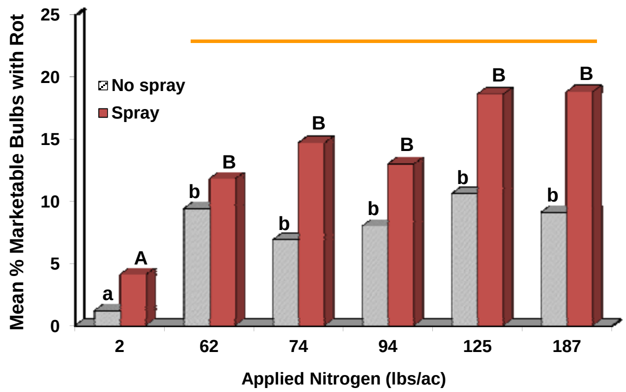

Figure 5. Plots that received nitrogen fertilizer had a significantly higher percentage of bulbs with rot. Columns with different letters are significantly different at $P < 0.05$.

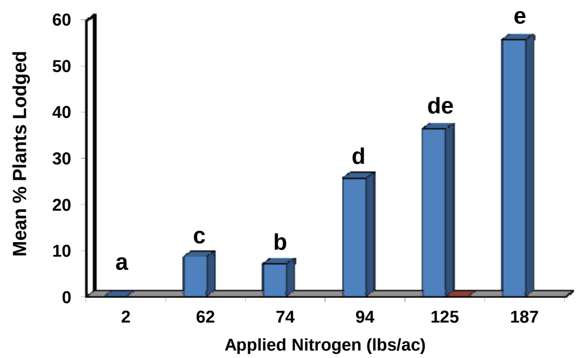

Figure 6. A significantly greater percentage of onion plants lodged by 18 August in plots that received higher levels of nitrogen fertilizer. Columns with different letters are significantly different at $P < 0.05$.

Discussion

Preliminary analyses of one of the fields confirmed the results found in the earlier experiment, plots receiving lower amounts of N fertilizer had significantly fewer larval onion thrips compared with plots receiving higher rates of N fertilizer. This may be due to possible negative effects that lower nitrogen levels in plant tissue could have on thrips colonization, reproduction, survival or emigration behaviors. Future analyses will estimate whether this reduction in larval populations can affect the number or timing of insecticide applications.

Bulb weights were not significantly different between plots receiving 74-125 lbs N/ac. We found a higher number of total bulbs > 2 inches in diameter in the highest N treatments (data not shown) but final marketable yield estimates will not be calculated until bulbs placed in storage are graded for rot. There was a trend for higher levels of rot in sprayed plots that received the highest levels of N fertilizer, but the differences were not significant. We anticipate that the cumulative pre- and post-storage percentage of bulbs with rot will result in significant differences in rot levels between the N treatment plots. Final counts of marketable bulbs after subtracting bulbs with rot could eliminate differences in preliminary estimates of bulb yields between the higher N treatments.

While more plants lodged earlier in the plots receiving the highest levels of N fertilizer, this did not appear to affect bulb weight, since the mean bulb weights were highest in the plots that had the highest percentage of plants that had lodged. The 2010 growing season was warm and onion plants matured sooner than usual resulting in almost no bulbs reaching large sizes (e.g. there were almost no jumbo-sized bulbs). This trial will be repeated 2011 and, in a cooler and longer growing season, plants that lodge sooner may affect final bulb weights.