Effect of high potassium fertility on Iris yellow spot virus incidence and symptom expression in onion

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Abstract

Iris yellow spot virus (IYSV) is an important disease concern for Utah, Oregon and Colorado onion growers. Virus management is difficult and is currently indirect by controlling thrips populations. Alternative management options are needed. In 2013, regression analysis of onion fields in Utah and Colorado indicated that soil potassium by itself, and in ratios with phosphorus and zinc, increased IYSV incidence in commercial fields. To explore this further, field trials were conducted in all three states across 2016 to 2018 to artificially increase soil potassium levels. The Utah field trials consistently showed an increase in the percentages of symptomatic and infected plants with increasing potassium levels. The untreated (no potassium added) control had an average of 22% symptomatic plants over the three years. In comparison, low and high potash treatments had 24 and 31%, and corresponding potassium sulfate treatments had 30 and 31% symptomatic plants, respectively. Colorado generally had lower IYSV pressure, but still showed the same trend; higher potassium levels led to an increase in IYSV incidence. In Oregon, the lowest potassium levels were much higher than UT or CO, and all treatments showed >70% IYSV incidence. Higher potassium rates also increased adult onion thrips numbers per plant. In this study, the increase in IYSV incidence and symptomatic plants may be indirectly correlated with soil potassium levels. Generally, plants in plots with high soil levels of potassium also had high levels of foliar potassium. There could also be a relationship with higher thrips populations or a currently unknown relationship.

Introduction

Iris yellow spot virus (IYSV) is transmitted by onion thrips. Infected plants developing symptoms early in the season produce smaller bulbs which results in a financial loss to the grower. Management of IYSV is difficult and is usually through targeting the vector. High cost of insecticide applications, the high risk of resistance development and clients requesting sustainably produced onions warrant the evaluation of alternative management strategies. In Utah, some fields show very low IYSV incidence despite heavy thrips feeding and adjacent fields have a high rate of IYSV. It was suspected that nutrient levels could play a role in disease incidence. A survey in 2013 showed that levels of potassium varied in fields; those with high soil potassium levels frequently having higher incidence of IYSV and fields with lower soil potassium levels frequently had lower rates of IYSV. The purpose of this project was to expand the survey results in replaicted field trials.

Acknowledgments

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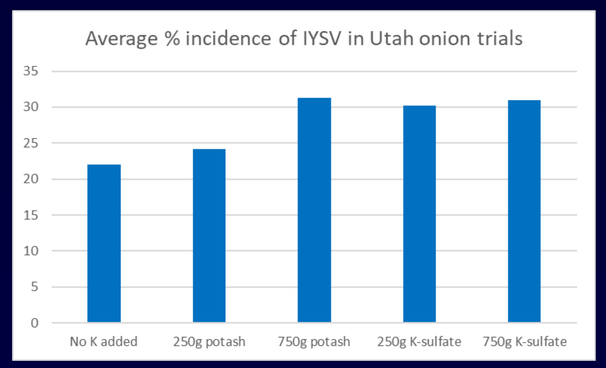
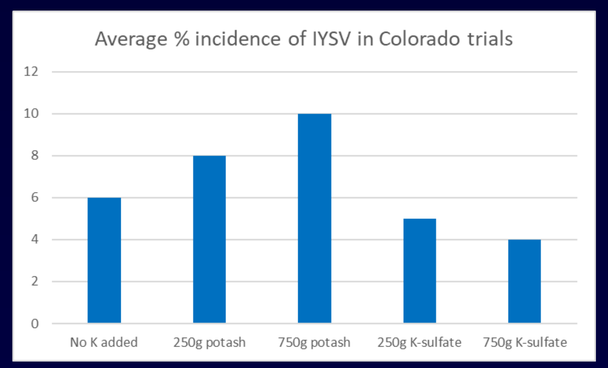
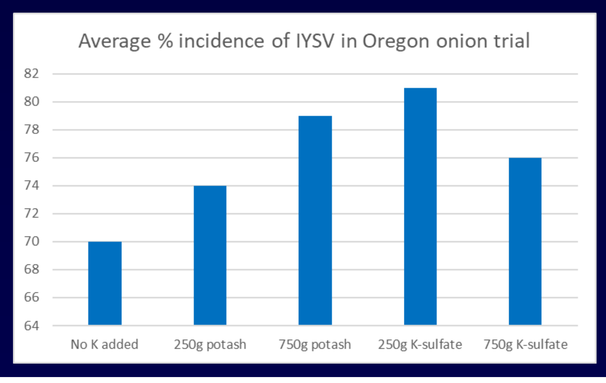






There were no significant differences in any trial

Materials and Methods

Trials were set up at research farms in Utah (2016-2018), Colorado (2016-2017) and Oregon (2016). Each trial consisted of five treatments: No added K, 250g/10ft row potash, 750g/10ft row potash, 750g/10ft row K-sulfate and 750g/10ft row K-sulfate. The onion variety used in the trials was 'Vaquero'. The onions were monitored throughout the summer. Soil and plant samples were collected and analyzed by the University of Georgia Soil, Plant, And Water Analysis Laboratory to determine the potassium levels for each treatment.

Leaf samples were collected in July (Oregon) and August (Colorado and Utah) and analyzed using enzyme-linked immunosorbent assays (ELISA) (Agdia) following manufacturer's protocol.

For thrips presence in Utah, whole plants were placed in soapy water and all the thrips were removed from the plant, separated into adults and larvae and counted.

Statistical analysis was conducted using SAS Proc Mixed.

Results and Discussion

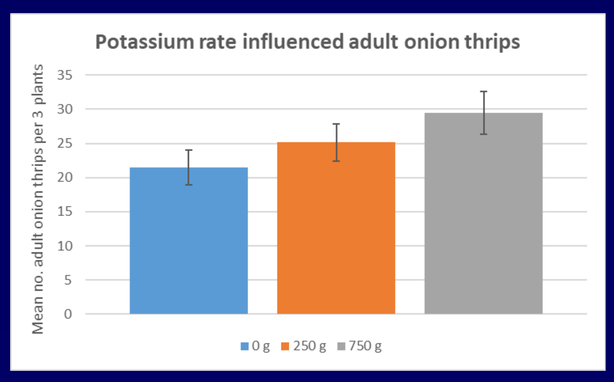
Over the three year trial in Utah, high levels of soil potassium consistently showed an increase in IYSV incidence. Due to variation within the treatments the results were not statistically significant. The same trend was observed in Oregon and Colorado. In Colorado, only the potash treatments showed an increase in incidence. In Oregon, the IYSV incidence was very high across all the treatments. The lowest K level in Oregon was already above the level in which increased incidence was observed in Utah under high IYSV pressure. At 264ppm a threshold may have been reached above which no significant increase in IYSV occurs. Despite the variation in K levels in treatments between the three states, high K levels increased IYSV incidence compared to the respective untreated control. The variation in K levels between states may be due to different soil types and climate that could affect leaching. Plant tissue in high potassium treatments had an average of 0.5-1.5% more K than plants in untreated plots.

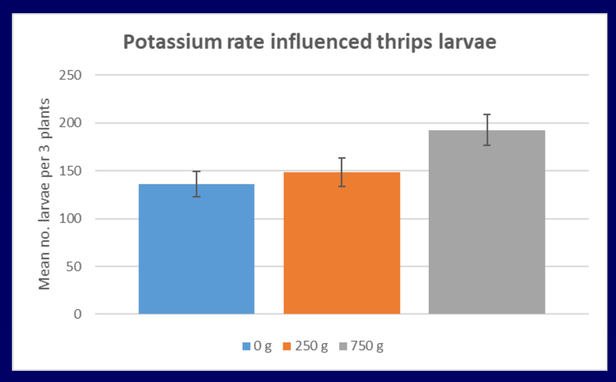
Onion thrips adults and larvae increased significantly in treatments with 750g K vs. untreated control.

The mechanism of IYSV increase by high concentrations of potassium is unknown. One possibility is the increased K levels in plant tissue in high K plots. A sample collected from a commercial field recently showed very low soil K levels but very high tissue K levels due to foliar K applications. Over 50% of the plants had symptoms of IYSV. Another possibility is the increased attraction of adult onion thrips to plants in high K plots, thus increasing the likelihood of IYSV infections or a currently unknown relationship.

Treatments	No K added (ppm)	250g/10ft row potash (ppm)	750g/10ft row potash (ppm)	250g/10ft row K-sulfate (ppm)	750g/10ft row K-sulfate (ppm)
Colorado	132	1253	3174	1030	3388
Oregon	264	687	1321	575	1417
Utah	94	220	428	184	419

Average soil K levels in treatments in trials in Colorado, Oregon and Utah





Number of adult thrips and thrips larvae per gram leaf tissue in 2018 Utah onion trial. Results are average across both potassium sources.