Jose Fernandez Memorial Chair of Crop Production
Annual Report (July 1, 2014 – June 30, 2015)
Christopher S. Cramer

Onion Cultivar Development

Open-pollinated, male-sterile, maintainer, and pollinator breeding lines were screened for disease resistance, bulb yield, bulb quality, maturity date, and bulb color. Promising breeding and hybrid lines and released cultivars were compared to commercial cultivars and experimental lines using observational trials. An autumn-sown and a winter-sown observational trial were conducted on a local grower's field. 'NuMex Allure' was released. It is an open-pollinated, late-maturing, intermediate-day, cultivar with red-colored dry outer scales. It matures in late July to mid August when winter-sown in southern New Mexico. This cultivar will satisfy a need for a red onion cultivar that matures at this time. One hundred and twenty-two selections of different lines were conducted this year. Seeds of 154 different lines were produced this year.

Fusarium Basal Rot Research

Seed of original, intermediate, and advanced Fusarium basal rot (FBR)-selected populations and one resistant and one susceptible check were sown in fields at the Fabian Garcia Science Center in Las Cruces, NM in October 2014. There were a total of 23 entries in the study that were replicated four times. In April 2015, cultures of *Fusarium oxysporum* f. sp. *cepae* isolate CSC 515 were initiated from infected, frozen wheat straw. Onion bulbs were inoculated with mycelium and spores from these cultures. The pathogen was reisolated from infected basal plate tissues of these inoculated bulbs. Infected bulbs served as an inoculum source for generating fresh inoculum and to maintain pathogen virulence. Small sections of infested basal plate tissue were placed on petri plates of potato dextrose agar (PDA) to encourage pathogen growth. Fungal spores were rinsed from these plates with distilled water and mixed with cooled, autoclaved PDA media to result in a final spore concentration of 3×10^5 spores$\bullet$ml^{-1} of PDA in the poured plates. Starting in May, bulbs were harvested from the planted populations once plants had reached maturity. Basal plates of harvested bulbs were cut transversely and a 1 cm diameter plug of PDA inoculum was applied to the cut surface. This inoculation method was determined from research conducted in the previous year. Bulbs were placed in black plastic crates and crates were placed in black plastic bags for 1 day to encourage mycelium growth and infection. After 21 days from inoculation, the basal plate of each bulb will be cut again and the basal plate will be rated on a scale of 1-9 where a 1 represented no diseased tissue and a 9 represented 70% or more of the basal plate tissue was diseased. As of the date of this report, basal plates had not been rated yet.

In September 2014, bulbs selected from the first and second generation lines of all seven cultivars were placed into separate locations in a field at the Leyendecker Plant Science Research Center to produce seed of each line in the following year. In April, those bulbs produced seedstalks and began the flowering process. Crossing cages were constructed and placed over the flowering bulbs. In May 2015, pollinators (honeybees and blue bottle flies) were introduced into the cages to pollinate flowers. These pollinators remained in the cages for 3-4 additional weeks. In July 2015, seed capsules will be harvested and seed cleaning will be initiated. Once seed cleaning is finished, seed of these selected plants will be placed in on-farm grower trials in the autumn of 2015.

Onion Thrips and Iris Yellow Spot Research

Germplasm was identified that possessed a reduced number of thrips per plant than most entries. Entries were identified that exhibited less severe IYS disease symptoms than most entries. Selection for reduced thrips number and IYS disease severity appears to be effective. Additional cycles of selection may be beneficial for increasing tolerance to thrips and/or IYS.

Sixty-nine onion breeding lines selected for reduced Iris yellow spot (IYS) disease symptom expression, 7 plant introduction (PI) accessions from the U.S. germplasm collection, 7 experimental breeding lines from the New Mexico State University (NMSU) breeding program, and 2 commercial cultivars were evaluated for the number of thrips per plant and IYS disease symptoms. Adult and juvenile onion thrips number per plant was highest at 13 and 16 weeks post transplanting. Among those breeding lines selected for reduced IYS symptom expression, plants of 68, 61, and 61 lines possessed fewer thrips at 10, 13, and 16 weeks after transplanting, respectively, than plants of the susceptible check, 'Rumba'. For those lines that were selected from PI 172703, plants of eight second generation lines had fewer thrips that plants of PI 172703 when thrips were counted at 10 weeks. In addition, plants of NMSU 12-298 and 13-225 had fewer thrips than plants of PI 546140 and 172702, respectively. Plants of NMSU 13-424 had fewer thrips than plants of NMSU 07-33-1 at 10 and 13 weeks. At 13 weeks, plants of six and three second generation lines had fewer thrips per plants than plants of PI 172703 and NMSU 07-53-1, respectively. At 16 weeks, plants of NMSU 13-273 and 13-426 had fewer thrips than plants of NMSU 07-53-1 and 07-52-1, respectively.

Among those breeding lines selected for reduced IYS symptom expression, plants of five lines exhibited less severe IYS disease symptoms than plants of 'Rumba' at 13, 16, and 19 weeks after transplanting. In addition, plants of 3 lines exhibited less severe symptoms than plants of 'Rumba' at 13 and 19 weeks. Plants of NMSU 12-243 exhibited less severe IYS than plants of 'Rumba' at 16 and 19 weeks. At 19 weeks, plants of 13 additional lines exhibited less severe disease symptoms than plants of 'Rumba'. At 16 weeks, plants of six selected lines exhibited less severe IYS than plants of their parental line, NMSU 07-53-1. Two of these lines exhibited a similar response last year. At 19 weeks, plants of NMSU 12-257, 12-261, and 12-774 exhibited less severe symptoms than plants of their parental line, PI 172703. A similar difference was observed for plants of NMSU 12-299 and its parental line, PI 546140.

Fourteen selected lines exhibited a lower IYS disease incidence than 'Rumba' at 13 weeks after transplanting. At 16 weeks, six selected lines exhibited a lower disease incidence than their parental line, NMSU 07-53-1. Five selections of different lines were made this year from this material. Seeds of 72 different lines were produced in this year.

Onion Germplasm Regeneration and Maintenance

In December 2014, seed of PI 546106 and 'Temprana' was sent from the onion breeding program at NMSU to the onion curator at the PGRU in Geneva, NY. Regeneration attempts of 13 PI accessions and six germplasm lines were in progress during this year. A new specific cooperator agreement was established for the next five years to continue our seed regeneration efforts for the USDA.

Outreach

On June 3, 2015, a field day was held to demonstrate the activities of the New Mexico State University onion breeding program. A presentation was given on the work being conducted to develop FBR-resistant cultivars.

Other

Our program continued to work with three minority students as interns with our program. One intern continued his research project examining the effects of nepatalactone on the activity of onion thrips on onions. The intern and his research are being supported through funding from the Cotter Work-Study Scholarship and the Howard Hughes Medical Institute Research Scholars Program. Our program employs four undergraduate genetics majors and two horticulture majors to gain valuable experience working with our research program. In an effort to further improve the efficiency of our breeding program, funds from the memorial chair were used to purchase crossing cage fabric and the fabrication of crossing cage covers that require less maintenance and have a greater lifespan than currently used fabric.

Publications

Refereed

Bag, S., H.F. Schwartz, C.S. Cramer, M.J. Havey, and H.R. Pappu. 2014. *Iris yellow spot virus* (*Tospovirus: Bunyaviridae*): from obscurity to research priority. Molecular Plant Path. doi: 10.1111/mpp.12177.

Cramer, C.S. 2014. 'NuMex Whisper' onion. HortScience 49:971-976.

Cramer, C.S., N. Singh, N. Kamal, and H.R. Pappu. 2014. Screening onion plant introduction accessions for tolerance to onion thrips and Iris yellow spot. HortScience 49:1253-1261.

Schwartz, H.F., D. Alston, J. Alwang, M. Bartolo, T. Blunt, C.O. Boateng, B. Bunn, C.S. Cramer, W. Cranshaw, J. Davidson, M. Derie, J. Doran, K. Douce, D. Drost, L.J. du Toit, J. Gao, T. Gourd, B. Gugino, R. Hammon, J. Hardin, M. Hausbeck, G. Jibilian, J. Lafferty, J. LaForest, M.S. McMillan, S. Krishna Mohan, J. Morrice, B.A. Nault, C. Nischwitz, G. Norton, K. Otto, H.R. Pappu, M. Petersen, R. Sampangi, B. Schroeder, W. Secor, S. Szostek, N. Tisserat, M.E. Uchanski, J. VanKirk, T. Waters, P. Wiriyajitsomboon, and C. Wohleb. 2014. Onion ipmPIPE: A coordinated effort to improve the management of onion thrips and *Iris yellow spot virus* for the U.S. onion industry. Plant Health Progress 15:172-183.

Abstracts

Cramer, C.S. 2014. Progress for reduced thrips number and Iris yellow spot in onions, pp. 25-26. In: Proc. 2014 National Allium Research Conf. W. Mininger and H.F. Schwartz (Eds.) Scottsdale, AZ.

Mandal, S. and C.S. Cramer. 2014. Selection progress for Fusarium basal rot resistance in onions, pp. 20-21. In: Proc. 2014 National Allium Research Conf. W. Mininger and H.F. Schwartz (Eds.) Scottsdale, AZ.

Other

Cramer, C.S. 2015. 'NuMex Allure' onion. NM Agric. Expt. Stn. Rel. Not., 20 pp.

Presentations

Breeding for resistance to Iris yellow spot. 2014 Annual Meeting of W2008: Biology and

Management of *Iris yellow spot virus* (IYSV), Other Diseases and Thrips in Onions in Scottsdale, AZ on December 4, 2014.

Utilization of Memorial Chair Funds

$13,430.14 towards salary enhancement and fringe benefits of chair holder.
$2,700.56 towards undergraduate student salaries and fringe benefits.
$5,670.00 towards honeybee hive rental.
$10,602.00 towards the purchase of crossing cage fabric and the fabrication of crossing cage covers.
$106.85 towards beekeeping expenses.
$158.15 towards other miscellaneous expenses.

Plans for Coming Year

Selections and seed production will continue towards the development of adapted onion cultivars. An autumn-sown, short-day, white cultivar is being considered for release. Fusarium basal rot research will continue with a second year of evaluation for selected material and seed production will continue. FBR-resistant germplasm will be evaluated in on-farm grower trials. Based upon the results from this year, a FBR-resistant cultivar may be released. Depending upon federal funding, developed populations will be evaluated for their onion thrips and Iris yellow spot tolerance and seed will be produced of selected populations. An Iris yellow spot tolerant germplasm line may be released this year. Seed production of onion plant introduction accessions will continue. A field day will be held to demonstrate the activities of the breeding program. The undergraduate interns will continue working for the program. One intern will continue his project examining the effects of nepatalactone on the activity of onion thrips on onions. In an effort to further improve the efficiency of our breeding program, funds from the memorial chair will be used to purchase crossing cage fabric and the fabrication of crossing cage covers. The program may expand into hobby beekeeping as both an educational opportunity and a research endeavor to support small-scale onion seed production.