Item No. 1 of 1

ACCESSION NO: 1019284 **SUBFILE:** CRIS
PROJ NO: WNP00009 **AGENCY:** NIFA WN.P
PROJ TYPE: MCINTIRE-STENNIS **PROJ STATUS:** NEW
START: 05 APR 2019 **TERM:** 31 MAR 2024

INVESTIGATOR: Yorgey, GE, .; Herman, BA, .; Chastagner, GA, .; Chen, SH, .; Ficklin, ST, .; Glass, JE, .; Kruger, CH, .; Lomber, JO, .; Jessup, ER, .; Gang, DA, .

PERFORMING INSTITUTION:
WASHINGTON STATE UNIVERSITY
240 FRENCH ADMINISTRATION BLDG
PULLMAN, WASHINGTON 99164-0001

ADVANCING FOREST/RANGELAND HEALTH AND ECONOMIC STABILITY IN WASHINGTON STATE

NON-TECHNICAL SUMMARY: Washington State contains approximately 21 million acres of forested land. There are more than 1,700 businesses in WA that are related to forest products, with a gross annual income of approximately $28 billion. The industry serves over 100,000 workers who collectively earn 3% of the wages that are paid in the State. Supporting this industry, while conserving natural resources, is a top-priority for Washington State citizens, stakeholders, and policy makers. Given this broad importance, there is a critical need for evidence-based research and outreach that can safeguard the industry from the myriad issues that it faces - this spectrum ranges from tree genetics, to pathogens/pests, to global change, and even the larger scope of producer/consumer economics and government policy.By drawing together multi-disciplinary research projects that are conducted at Washington State University, the 'Advancing forest/rangeland health and economic stability in Washington State' McIntire-Stennis project intends to collectively advance forestry-related research and scholarship that will have real and lasting impact on the industry and the State's natural resources, safeguarding it from challenges relating pathogens and pests and changing fire and climate risks, and generating new opportunities relating to improved genetics, new transportation technologies, and new products that could benefit both producers and consumers. In this granting period, our efforts will focus on six areas that are of increasing regional and national concern, including: (i) Using diagnosis, pathology, and management to combat devastating diseases that affect forest trees, forest land and high-value ornamentals; (ii) Developing and testing new clonal hardwoods that meet stringent industry standards; (iii) Advancing databases and data curation techniques for examining the relationships among genetic, phenotypic and environmental factors that influence forest tree biology; (iv) Developing strategies to enhance resilience of forest and related rangelands systems to current and future risks relating to climate and fire; (v) Developing and evaluating alternative wood-based products that could provide renewable energy or improve soil health; and (vi) Evaluating new strategies for improving the efficiency of the transportation of forest products from harvest to

destination.Through research in these six intersectional areas, and outreach to relevant stakeholders - including the breadth of individuals involved in forestry and forest products industries; regional ranchers and rangeland managers; managers of forestry and related rangelands, and the general public - this project will provide results that help maintain resilient and sustainable forested and non-forested lands, and support economic growth throughout the state and region.

OBJECTIVES: The goal of this project is to generate evidence-based research and outreach that can contribute to safeguarding the forest industry from many of its current challenges: (1) understanding and employing new advancements in tree genetics; (2) managing and reducing losses due to pathogens/pests; (3) maintaining and expanding the library of available clonal hardwoods; (4) adapting practices and policies to meet global change, (5) developing new processes for generating products from forests/forest residuals and evaluating the value from emerging products; and (6) overcoming deficits in transportation for logging operations and associated industries.Major supporting objectives of the project include the following:Obj. 1: Enhancing genomic databases to examine the relationships among genetic, phenotypic and environmental factors in forest plants. (Ficklin)Obj. 2: Combating devastating diseases that affect forest trees and forest land in remote- and urban locations - including diagnosis, pathology and management. (Chastagner, Glass)Obj. 3: Developing and testing clonal hardwoods that meet the industry requirements (Herman)Obj 4: Promoting resilience of forest and related rangelands systems to current and future risks relating to climate and fire. (Kruger, Yorgey)Obj. 5: Developing new processes for making value-added forest residue- based products, and evaluating emerging forest-residue-based products. (Chen, Lomber, Yorgey, Gang)Obj. 6: Determining the transportation needs and challenges facing the forestry- and forest products industries. (Jessup)

APPROACH: Obj. 1: The development of a new micro-services based architecture for Tripal 4 will include assisting efforts for data exchange, data integration, collaboration on large-scale phenomic and environmental data, and integration with high-performance computing facilities. Tripal adoption will be fostered by performing outreach to forest tree databases, and ensuring representation at monthly and yearly meetings, steering, and advisory committees. Obj. 2: Surveys of conifer nurseries will help determine the diversity of Botrytis species that cause gray mold on PNW conifer nursery stock. Morphological and molecular approaches will be used to identify isolates to species. Replicated seedling inoculation trials will confirm the pathogenicity of any novel Botrytis species. Botrytis isolates will be screened for sensitivity to fungicides used by PNW growers. Replicated laboratory tests will indicate the ability of isolates to grow on media amended with different concentrations of each fungicide. The concentration of fungicide needed to inhibit the growth of each isolate by 90% (ED90) will be calculated. New, reduced-risk fungicides and biopesticide products will also be tested on conifer nursery stock and in replicated disease control trials to determine effectiveness. Tests will include a postharvest evaluation to determine the effect of preharvest treatments in reducing storage losses. To improve producers' needle cast disease management programs, standard laboratory and greenhouse inoculation procedures will be used to determine the etiology of emerging needle-cast diseases. Replicated in-vitro and field trials will determine the optimal timing and efficacy of fungicides in controlling noble fir seedling and tree disease development. Genetic variation in adaptability and health of pacific madrone trees will be monitored in replicated common garden plots that contain trees from 103 families of this host. Total height, flowering, winter damage and the severity of leaf blight will be measured. Regional adaptability and postharvest quality of exotic conifers will be evaluated for potential use as

Christmas trees via total height, branching and foliage quality. Timing of bud break will also be assessed by monitoring once a week over 4 to 6-weeks. Ambient temperatures will be used to calculate the mean and variation in growing degree days associated with bud break. Variation in needle retention will be assessed on 2-yr-old branches harvested from each tree and displayed without water at 68F for 7-14 days. The WSU Puyallup Plant & Insect Diagnostic Lab will provide diagnostic services, utilizing methods including researching information on plants and common problems, identification of pathogens and pests through microscopic examination, plating tissue onto growth culture media, or diagnostic molecular methods involving ELISA, PCR or other methods. Diagnostic and management information will be shared via written communication pest alerts, and incorporated into lectures and hands-on diagnostic workshops. Obj. 3: New alder clonal selections are generated annually with subsequent field trials across a range of sites for performance evaluation. WSU maintains a bank of Frankia alni, a nitrogen-fixing symbiote of alder, and tests their performance with the new tree selections. We will also continue to expand our current selection of Frankia to include more from marginal sites. Inoculate is provided to seedling nurseries annually. The best performing, least genetically related, clones are planted in a hedged breeding orchard for annual controlled cross breeding and seed production. Once controlled crosses are completed, a small supplemental mass pollination of the trees will be performed with improved pollen and the seed collected. The resulting seedlings will be planted on private growers' lands for future clonal selection. Finally, to preserve ageing, but genetically important poplar material from older selections, axillary buds will be propagated from trees prior to senesce or removal. This material will be maintained and serially propagated to keep a living germplasm bank critical for future breeding efforts. Obj. 4: This work will utilize social science methodologies including semi-structured interviews and focus groups to better understand the needs, barriers and opportunities related to strategies that could be used to mitigate current and future climate- and fire-related risks, and support for improved decision-making. Obj. 5: Microbiological-, chemical-, and analytical techniques will be used to develop novel processes for pre-treating lignocellulosic biomass to reduce recalcitrance and convert lignocellulosic constituents into bioproducts and bioenergy, including (a) selective deconstruction of lignin from lignocellulosic biomass; (b) development of radical based process for pretreating the lignocellulosic biomass to remove the recalcitrance; (c) development of cell factories for converting cellulosic sugar to biochemicals; and (d) integration with separations, purification, and finishing processes to produce bioproducts. Work on biochar and co-composted biochar will utilize fieldstudies includingpotatoes, strawberries, and basil. Analysis of soil and plant quality with compost, biochar, combined compost and biochar, and co-composted biochar will be performed. Soil quality will be assessed by measuring penetrability, nutrient supply, microbial growth, and carbon storage. Plants will be evaluated for plant production (leaf or fruit yield) and quality (color, flavor, nutrients). Quality traits will be measured for a subsample, including mass spectrometry-based composition analysis of primary and important specialized metabolites. Experiments will be replicated 3 times. Potato tuber yield, marketable yield, and tuber size distribution will be determined using standard methods. Obj. 6: The activities will rely on a survey of sawmill operations in the PNW, freight transportation modeling, and geo-spatial analysis techniques. Activities will include: determining the frequency of trucks on corridors near the survey sites during the anticipated survey times, which informs sample size for statistically valid data collection; identifying peak seasons, peak months, peak days, peak days of week, and peak hours; determining truck origin and destination; examining interrelationships using vector autoregression (VAR), including vector error correction (VEC) and associated impulse response functions (IRFs); use of directed acyclic graphs (DAGs) to obtain additional information on any causal relationships that may exist between the variables in a vector autocorrelation model.

Evaluation: All team members will be involved in evaluation with metrics including but not limited to (1) maintaining/increasing the number of active users of the TreeGenes database; (2) reliable, accurate and timely delivery of diagnostic results to WA citizens and stakeholders (determined by internal audit); (3) number of clonal alder trees successfully preserved and propagated, and stakeholder requests for germplasm; (4) increased availability of fungicidal agents (traditional and bio-based) to combat Botrytis; (5) working papers on agricultural transportation needs in WA state; and (6) laboratory/greenhouse level demonstration of functionality using value-added chemicals and compounds from forest-based feedstock.
