*Western SARE Competitive Grants: Graduate Student*

***New tools to manage understories for ecological value in organic hazelnut orchards and matrix oak woodland habitat.***

**A. Project Basic Information**

Primary subject matter:

Proposed starting and ending dates:

Where the project will be conducted: Willamette Valley, Oregon

Main commodities and practices of the proposed project:

**B. Project Team**

Principal Investigator: Dr. Lauren Hallett.

Graduate Student*:* Alejandro Brambila

Producer cooperators:

* Taylor Larson: Co-owner of “My Brother’s Farm”. A diversified organic farm that includes riparian forest and oak woodland. Among other things, Taylor produces hazelnuts, apples, pork and bison.
* Marissa Lane-Masse: Conventional, large scale hazelnut prodcuers. The Lane-Masses have been growing hazelnuts for over 60 years on X total acres.
* Contract filbertworm monitoring farm: X have been producing hazelnuts organically and monitoring filbertworm populations on their farm since \_\_\_ and are interested in participating in alternative methods.

*-Betsey somehow?*

\*include CV, Current and Pending, Conflict of interest

**C. Summary** (250 words)

Description of the problem, a creative approach to solve it, and why it is important. Clearly ID research question, explain how you will disseminate findings among producers, agricultural professionals, and academic community. ID significance of project and expected outcomes. Clear and concise.

**D.** **Narrative** (5000 words max)

* *Farm is a part of the broader ecosystem, relies on it and interacts with it. Manage them together for mutual benefit.*
* *to make it more agriculture focused, you could frame it more about strategies to sustain organic multi-functional farms. Challenges to this are controlling pests and promoting beneficial species. Your framework is that understory management is the way to do it (rather than jumping straight to understory and conservation). A slight tweak, but might help it seem more relevant to producers.*

*Relevance to Sustainable Agriculture (800 words – currently at 1200)*

Hazelnuts are a booming industry in Oregon’s Willamette Valley, where 99% of the US crop is produced. The vast majority of hazelnuts are farmed in monoculture using conventional methods to produce a commodity crop for sale overseas. As this industry expands, it is at a crossroads. Will hazelnuts be grown as a commodity, or sustainably? While the commodity route has so far returned healthy profits to farmers, these are at risk from global politics and have come at the cost of environmental degradation across the farm-wildland matrix.

Here, we propose a set **of strategies to promote sustainable multi-functional hazelnut farms in the Willamette Valley**. Key challenges to expanding farm multifunctionality (social and ecological services and values) are controlling pests and promoting beneficial species. We have identified key opportunities to develop desirable plant and invertebrate communities through understory management. Across the landscape, understory management can connect farmed and natural areas, either through conflict or mutual benefit. Traditionally, conventional farms have used intensive spraying, flailing, and scraping to eliminate pests and understory vegetation in the orchard and increasingly throughout their properties. We suggest that instead of posing a threat, the hazelnut boom poses a unique opportunity to develop novel approaches to understory management across the farm-wildland matrix. **Our overarching goal is to develop win-win solutions for conservation and sustainable farming across the farm-wildland matrix.** Specifically, we propose to test alternative strategies of grazing to reduce pest loads and incorporating native cover crops to support soil and wildlife communities.

Before widescale land conversion, much of the Willamette Valley was dominated by diverse oak-savannah, woodlands and grasslands. These habitats, collectively referred to as “oak-prairie” have been reduced to less than 5% of their original extent. Of these remnants, over 80% are on private, often agricultural, lands. Oak-prairie habitats are therefore among the most endangered ecosystems in the Pacific Northwest, and working with farmers for their protection is essential for their conservation. Accordingly, the Oregon Department of Fish and Wildlife has recognized these as “priority” habitats for conservation and work is ongoing to restore and manage them. They also have cultural value, native people, resources, supporting native pollinator base for western Oregon. Through increasing the ecological value of farms, sustainable hazelnut farming can play a role in supporting and preserving and these systems.

In 2016, a small but growing number of farms organized to form the Oregon Organic Hazelnut Cooperative to support organic growers through educational outreach, nut processing and marketing. A transition to organic hazelnut production has the potential for increased profits, more stable markets, and the support of healthier local ecosystems. At the same time, there are challenges that limit the widespread adoption of sustainable approaches. In fall 2017, members of the OOHC reached out to Hallett for advice on pest management, a central challenge for organic farms that limit their use of synthetic insecticides. Specifically, the filbertworm, *Cydia laiferreana,* is a native moth that burrows into nuts and renders them inedible. Organic producers rely on a combination of OMRI pesticides, pheromone mating disrupters, and nut removal to reduce filbertworm pest pressure. Because the larva burrows in nuts, removing all nuts from the ground at the end of the growing season breaks the month’s lifecycle and curtail its population size.

Although this combination of approaches to organic filbertworm management can be effective at the local level, it can be confounded by dynamics over the larger farm-wildland matrix. Specifically, the filbertworm’s native host is the Oregon white oak (*Quercus garryana*), a major component of oak-prairie ecosystems. Oaks near orchards serve as source pools of pests to re-invade hazelnuts. As a consequence, there is pressure on organic growers to remove oaks from their lands. This represents a potentially large clash between environmental and production aims.

Our focus is to develop a solution that protects organic farms against filbertworm infestation while at the same time conserving rare oak habitat. **A promising strategy to address this oak conservation-sustainable farming conflict is to co-manage oak and hazelnut understories by grazing for acorn and nut removal**. Pigs have a preference for acorns, and acorn-fed pig is an increasingly popular food type in the US. We hypothesize that pigs can be used to indirectly reduce pest pressure by removing acorns and nuts that would otherwise host the moth larvae. This type of pest control has successfully been employed in other systems such as the use of chickens for blueberry pest management. This project is relevant to the components of sustainable agriculture through adding a revenue stream (pork), increasing the value of nuts (organic), preserving native oak habitats, and reducing the exposure of farmers and farming communities to pesticides.

In addition to managing the farm understory to reduce pest loads, hazelnuts require considerable understory management to facilitate harvest. Hazelnuts are harvested from the ground, using tractor-pulled sweepers. To gather the nuts, farmers need a clean, level orchard floor. Traditionally, this floor has been maintained through annual spraying, flailing and scraping. This results in a sterile understory with no vegetation to stabilize and shade soils, or provide habitat or forage for wildlife*.* In recent years, OSU has been suggesting hazelnut farmers plant cover crops to improve the stability and health of orchard soils*.*

We propose that orchard understories provide another potential mutually beneficial opportunity for the goals of production and conservation. In addition to the boom of new orchards being developed, many of the oldest orchards (80-100 years old) are being replanted lowering the average orchard age. While mature orchards have closed canopies resembling woodlands, these younger orchards with open canopies are structurally similar to oak-prairie habitats. **Our goal is to test the potential for using native prairie plants as a cover crop in hazelnut orchards.** This would not only provide cover crop benefits to the orchard, but also provide a unique opportunity to perform a partial restoration on prime agricultural land that is generally too economically valuable to restore outright. Prairie plants, like typical cover crops are quick to establish, small in stature, and senesce by fall harvest. Especially in young orchards with immature trees, these plants can help anchor, shade and build soil. Within the context of the farm-wildland matrix, extending a prairie understory below orchards can support wildlife including native pollinators which are essential to the success of many regionally important crops including blueberries, apples and marionberries.

A major limitation to the use of native plants as a cover crop is their cost. To be economically feasible, prairie plants must create-self sustaining populations and not require reseeding year after year (potentially resulting in long-term economic savings). To create sustainable populations, these plants must survive (perennials) or reach maturity and produce seeds in the context of orchard management activities. We will test the compatibility of selected prairie plants with different management activities and canopy structure. Specifically, we will examine the effects of flailing and scraping in orchards of varied maturity. We will also pay specific attention to factors relevant to sustainable farming including soil moisture, amount of exposed soil, and pollinator presence.

Here, we present ecologically-based strategies of understory management to support sustainable whole-farm systems. Our overarching goal is to support sustainable hazelnut production in the Willamette Valley by lowering practical barriers. Adoption of sustainable farming practices will not only benefit the local farming community but also play a major role in regional ecological conservation efforts. We have researched the topic and consulted with OOHC, Dr. Betsey Miller (a filbertworm expert) at OSU, and Dr. Lauren Ponisio (a farmland pollinator expert) at UC Riverside to inform our research design and confirm that this work is underexplored in the academic literature. We will continue this iterative engagement throughout the course of the project to ensure that our findings are widely disseminated and applied

*Objectives (300 words – currently at 520)*

Our **overarching objective** is to develop novel strategies of understory management on hazelnut farms to increase farm multi-functionality and facilitate sustainable agriculture. These strategies include pig grazing of infected nuts to reduce pests and incorporation of native prairie plants as cover crops.

H1) Pig grazing in oak and hazelnut stands will reduce the proportion of infected acorns and nuts. We predict that pigs will preferentially graze acorns and hazelnuts when confined in areas where these are available. Because infected nuts fall early, timing pig rotations early in the season will preferentially remove infected seeds. We will establish plots below trees and measure the total number of infected nuts and acorns before and after pig grazing to assess the effectiveness of pigs in removing pest vectors. Our hypothesis will be supported if there is a significant decline in infected acorns relative to total acorn densities after grazing.

H2) Pig grazing in oak and hazelnut stands will reduce filbertworm pressure. If infected acorns are removed, the filbertworm lifecycle should be interrupted, and their population sizes should decrease. We will measure filbertworm populations using emergence and aerial traps before and after grazing in a grazed and control plot using a BACI design. Our hypothesis will be supported if filbertworm densities at significantly lower in areas that have been grazed compared to those areas prior to grazing or in controls. We expect to see these results both in oak stands and in the orchard. Because of a potential lag effect where an interruption in filbertworm lifecycle one year doesn’t show up until adults emerge the following spring, populations will be monitored over two years.

H3) Native cover crops will survive and reproduce in a working orchard context. We predict that robust native species that produce large amounts of seed will be able to establish and persist in a working orchard context. We have chosen locally harvested seeds from species that are adapted to environmental conditions where orchards are located. We have also chosen species that are adapted to the savanna-like structural overstory conditions present in orchards. By comparing the survival and reproduction of various native annual and perennial forbs and grasses with that of traditional cover crops (wheat, barley, clover), we will identify appropriate species for use as cover. Our results will be supported if we find comparable cover of natives to cover crops, and if natives reseed and continue to provide cover over time. To carry out this objective, plots established in hazelnut orchards will need to be observed for a minimum of two growing seasons (fall-summer).

H4) Native cover crops will provide comparable benefits to traditional cover crops. If natives establish and survive in orchards, we expect they will provide similar or greater levels of soil shading, soil moisture, erosion control, soil building and pollinator attraction as traditional cover crops. To asses these services, we will use percent bare ground as a proxy for shading and erosion control, spring soil moisture monitoring, peak standing biomass to represent potential carbon inputs to the soil, and pollinator surveys. Our results will be supported by comparable or improved levels of each metric.

H5) Something about economics?

*Research Materials and Methods (1500 words – currently 2000)*

Part 1: Pest management

**Study sites**

We propose to test the effective ness of pig grazing to reduce filbertworm pest pressure in hazelnut stands embedded in an oak woodland-agricultural matrix. We are testing this approach at two farms. My Brothers’ Farm, is a 320-acre OOHC member farm in Creswell, OR has over 2000 young hazelnut trees, and also produces cider apples, bison and pork on a property with several old oak stands. Here, we will focus on the pigs ability to clear acorns in the oak matrix habitat, reducing overall farm pest pressure. A seed grant through the University of Oregon allowed us to collect baseline measurements and implement experimental treatments in summer 2018 and 2019. With this grant, we hope not only to collect filbertworm population response data, but to expand our pest management experiment to X Farm, also a member of OOCH. X Farm has a more established orchard that has had ongoing filbertworm monitoring for the last X years. Here, we will focus on the pigs ability to reduce pest pressure directly in a productive orchard with a known level of pest pressure. Measuring treatment response is labor intensive but essential to understanding the viability of our approach. Below we outline the proposed treatments and response variables to be implemented and recorded with this grant.

**Treatments**

In the summer of 2018 we established paired control and treatment plots in oak stands at My Brothers Farm, and propose to do the same at X farm in a mature hazelnut orchard in summer 2020. In one plot we implemented a pig grazing program, while restricting grazing in the other. Plots size is five acres, reflecting potential radius of a filbertworm flight path. We used movable electric fences to implement the treatments, grazing each plot in rotating pastures for a total of two weeks. Grazing (performed by 20 heritage pigs) was timed to correspond with initial acorn release (Sept-Oct) to target infected acorns as they are aborted and dropped before full masting. The grazing treatment was implemented by Taylor Larson, co-owner of My Brothers’ Farm. Because acorn production and filbertworm populations can vary year-to-year, this process was repeated in 2019. We have designed measurements using a Before-After Impact-Control (BACI) design to allow contrasts in the same plot before and after treatment as well as contrasts between the grazed plots and paired control.

**Measurements**

To test H1: pig grazing in oak and hazelnut stands will **reduce the proportion of infected acorns and nuts** by preferentially grazing acorns and hazelnuts when confined in areas where these are available, we will sample nuts and count infected and healthy totals. At My Brothers’ Farm we will select five large oaks within each plot (grazed/ungrazed) that are known to produce many acorns. At X farm, five healthy hazelnut trees will be selected at random. Below each tree, two 2m x 2m plots will be established on opposite sides of the tree and cleared of vegetation. This will be removed from the trunk of the tree a distance of 0.5 times the width of the canopy. Immediately before and after pig grazing, nuts/acorns will be counted and checked for any signs of filbertworm infestation (entry/exit holes). This will be done both in grazed and ungrazed plots to account for seed predation from other sources including birds and deer. We will used paired t-tests to compare acorn densities between grazed and ungrazed sites before and after grazing. To reduce filbertworm populations, pigs will have to comprehensively remove infected acorns/nuts during the grazing treatment.

To test H2: grazing reduces filbertworm pest pressure, we will explicitly measure the effect of grazing on filbertworm density. We created 0.5x 0.5m emergence traps by building wooden frames covered in netting, with a pheromone trap at the top of the top to lure and capture any emerging filbertworms. At My Brothers’ Farm, we used 10 traps per plot and monitored them weekly during filbertworm emergence (May-July). In addition we used 4 aerial pheromone traps to measure moth densities over the course of the summer. These methods were successful in capturing moths and establishing that initial densities were high in oak stands. We propose to replicate this sampling design to test our hypothesis that grazing will reduce filbertworm densities the following year, once the filbertworm life cycle has been interrupted. We will also replicate this design at X farm in a mature hazelnut orchard with a long established monitoring history of filbertworm populations using aerial sticky-trap measurements.

Part 2: Beneficial species

**Study sites**

We established native understory plantings at three orchards in the Willamette Valley. **Considering different orchard ages will help us answer the question whether** **trees of different ages can affect cover crop success through differing levels of competition, shading and leaf litter.** The first orchard, at My Brothers’ Farm, consists of five year old trees and is located in Creswell, OR (near Eugene). The second (Keizer, OR) and third (North Howell, OR) orchards are both owned by the Lane-Masse family. The orchard at Keizer is 60 years old, and the orchard at North Howell is mostly 40 years old, but has a section (two rows) on the edge of the orchard with 15 year old trees. The five year old trees have the most open canopy, followed by the 15 year old and the 60 year old, whose canopy has opened due to pruning and dropping of diseased limbs. In full leaf, the 40 year orchard has an almost completely closed canopy.

**Treatments**

Within each age of orchard, we established six blocks (total 24 blocks) approximately 6 m x 18 m. Each block consists of three management-level plots: “no management”, “flailed”, and “flailed + scraped”. These plots are adjacent to each other between two rows of trees, and are bounded by trees at each corner (see attached figure). They represent different levels of orchard floor management intensity from the typical flailing (large-scale mowing/ branch chipping) and scraping (a tractor attachment that floats at a predetermined height and is pulled, leveling and mechanically disturbing the soil) to “no management” where only occasional tractor traffic and harvest sweeping disturb the plot. **With management plots, we will test the compatibility of native cover crops with typical orchard floor farming techniques, and identify which of these is most relevant to their success/failure in establishing and surviving.**

Within each plot, we established four 2.5 m x 2.5 m sub-plots seeded with different groups of native and conventional cover crop species. **This is to evaluate the potential of different native species as a hazelnut orchard cover crop.** All species were purchased from Heritage Seedlings, the largest local purveyor of native, wild-collected seeds from within the Willamette Valley. Working with local prairie experts, we selected 19 native species: eight annuals forbs, eight perennial forbs and three graminoids (see Table 1). Within each of these functional groupings, we selected species that are common and persist in remnant natural grasslands, perform well in prairie restorations, and establish quickly and reproduce profusely. We selected species that perform well from full sun to partial shade. From these groups we developed four seed mixes: annuals, perennials, unmanaged natives, and industry control (see Table 1, and attached figure). Clockwise from the northwestern subplot, the seed mixes applied are annuals, perennials, true control (no seeds applied), and industry control. We did not seed an industry control in the no management plot, because we decided it would not be relevant in an unmanaged context. Instead, we seeded the “unmanaged natives” mix, which contains all of the annual and perennial forbs, as well as the three graminoids. This was primarily to limit the amount of grasses used (a concern of our farming partners) and to test for competitive/facilitative interactions between annuals and perennials. Each subplot was seeded at 8g/m2, regardless of the number of species in the seed mix. Each species in a mix was seeded at the same rate by weight (i.e. 1g/m2 in annual and perennial mixes) in November 2019.

|  |  |  |  |
| --- | --- | --- | --- |
| Species | Native | Functional group | Seed Mixes |
| Collomia grandiflora | Yes | Annual forb | Annuals, unmanaged natives |
| *Amzinckia menziesii* | Yes | Annual forb | Annuals, unmanaged natives |
| *Clarkia purpurea* | Yes | Annual forb | Annuals, unmanaged natives |
| *Epilobium densiflorum* | Yes | Annual forb | Annuals, unmanaged natives |
| *Gilia capitata* | Yes | Annual forb | Annuals, unmanaged natives |
| *Lotus purshianus* | Yes | Annual forb (legume) | Annuals, unmanaged natives |
| *Plectritis congesta* | Yes | Annual forb | Annuals, unmanaged natives |
| *Sanguisorba annua* | Yes | Annual forb | Annuals, unmanaged natives |
| *Achillea millefolium* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Agoseris grandiflora* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Lomatium nudicaule* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Potentilla gracilis* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Prunella vulgaris* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Viola praemorsa* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Geum macrophyllum* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Eriophyllum lanatum* | Yes | Perennial forb | Perennials, unmanaged natives |
| *Danthonia californica* | Yes | Perennial graminoid | Unmanaged natives |
| *Festuca roemeri* | Yes | Perennial graminoid | Unmanaged natives |
| *Carex tumulicola* | Yes | Perennial graminoid | Unmanaged natives |
| Winter barley | No | Annual graminoid | Industry control |
| Common oats | No | Annual graminoid | Industry control |
| Common vetch | No | Annual forb (legume) | Industry control |
| Climbing pea | No | Annual forb (legume) | Industry control |

Table 1: Selected species, characteristics and seed mixes.

**Measurements**

To evaluate H3: whether native grassland species can be succesfully used as a hazelnut row cover crop, percent cover will be estimated at the end of each month from January to June 2020. At peak biomass, each species success will be evaluated by sampling across each subplot with two line-point intercept transects of 50 hits each, crossing in the center of the plot. We will estimate percent cover of each species, representing its level of success in establishing and surviving the growing season. Without the addition of more seeds, this process will be repeated from January to June 2021 to evaluate the ability of each species to successfully reproduce, resist invasion by weeds, and maintain a viable population over time.

For our project to be successful, we not only need the native seedlings to survive and reproduce, but also H4: to **provide the intended benefits to the farm and the broader ecosystem**. These include soil stabilization and building, shading and moisture retention, and supporting populations of native pollinators.

Pollinators are a key piece of an interconnected farm-wildland landscape. Many farmed and native plants rely on pollinators to produce or reproduce. While crops can provide forage value for native pollinators, a diversity of native plants provides more diverse food resources, and extends the time when resources are available. We will monitor pollinator visits to subplots planted with different seed mixes in the spring of 2020. Observers will spend 5 minutes in each subplot, noting each visit to a flower by a pollinator and identifying the pollinator with the most precision possible.

Cover crop roots can help anchor the soil, minimizing losses to erosion. To test whether we are successfully **minimizing erosion risks**, we will estimate the amount of bare ground exposed throughout the wet/growing season (January to June 2020 and 2021). Each native seed mix will be analyzed against the industry control and true control (no seeds added).

Hazelnuts (especially young trees) rely on soil moisture being available as long as possible into the spring. In the Willamette Valley, nearly all precipitation falls between October and May, with the majority falling from December to March. By mid-summer, orchard soils can get very dry, prompting farmers to water trees weekly (often by hand). We will install soil moisture probes to test **whether native cover crops increase soil moisture** in the spring through shading the soil. We will measure soil moisture in four locations in each subplot every other week from March to July in 2020 and 2021.

In addition to short-term effects, cover cropping can have long term benefits for the soil, primarily through the incorporation of organic matter containing carbon and nitrogen to the soil. This organic matter increases soil fertility, water holding capacity, and can help resist compaction. We will use standing biomass as an indicator of the level of **soil building provided by our cover crops**. At peak standing biomass (in June 2020/2021), we will clip all aboveground biomass in a predetermined .25 m x .25m square portion of each subplot. Biomass will be dried in a 60 \*C oven for 48 hours and weighed.

*Educational Outreach Plan (500 words)*

1. Communication of the project activities and their findings to producers and the general public. Yearly plan for outreach. Should identify dates, locations, and methods for outreach using field days, workshops, demonstrations or other networking events. Address how the project outreach products will be disseminated among producers not directly involved in your events. (Media, websites)

*Scholarly Publications & Educational Materials (500 words)*

1. Both scientific publications and targeted extension/outreach publications are required outcomes. Ex: 4-H, videos, posters, slideshows, brochures, fact sheets, surveys, web materials. How will these get to the hands of producers?

*Evaluation of Producer Adoption (300 words)*

1. How will the project educational material and outreach be evaluated. How changes in producers’ knowledge, awareness, attitudes, new skills and practices will be measured using surveys, interviews, etc. You can use the WSARE Survey online, fill it out by every participant at each outreach event in addition to any other evaluation form. This is required annually.

*Timeline (300 words)*

1. Gantt chart of milestones and activities.

*Innovations and Contributions to Sustainable Agriculture (500 words)*

1. Evidence of originality and innovativeness of the project and its contributions to the body of knowledge of sustainable agriculture. Potential impacts at local state, regional levels. How will the project outcomes affect overall productivity, profit, soil or water quality or quantity, communities, and society as a whole. Use specific estimates of benefits such as dollars per acre, tons of soil protected from erosion, pounds of chemical reduced, number of acres or people affected, markets expanded, jobs created, etc.
2. Notes from taylor:
   1. How will the project outcomes affect overall farm/ranch productivity?
      1. reduced filbertworm pest pressure due to pig grazing
      2. reduced filbertworm pest pressure due to increase in natural predator habitat (This is mostly ground beetles so not sure how much we'll be able to boost this if we are still mowing...)
      3. increased land and food for pig production
      4. increased nut production due to diverse cover crops?
   2. How will project outcomes affect overall farm/ ranch profitability?
      1. Reduce need to spray for filbert-worm (Cost ~$200/acre/year) \*Organic
      2. Increase profit margin for pig enterprise by growing more of their food (this is the main cost in raising pigs)
      3. Compelling story for farm to share with their customers
   3. How will the project outcomes affect Soil health?
      1. Integrating livestock into the orchard brings in important soil nutrients
      2. A diverse "cover crop" provides food for a diversity of soil organisms--> healthy soil
      3. A diverse "cover crop" reduces soil erosion from wind and rain
   4. How will the project outcomes affect Water quality?
      1. Reduced need for pesticides that end up in the water supply (see EWEB project)f
      2. Reduced need for fertilizers that end up in the water supply
      3. Increased ability for the system to hold nutrients (and water?)
   5. Benefits for Community/Society
      1. Cleaner Water (fewer pesticides and nutrients in the water supply)
      2. Increased biodiversity across the landscape
   6. Reduced risk for localized extinctions if species are able to move through the agricultural landscape
   7. Closer integration of oak/prairie restoration efforts with sustainable agriculture

Organic=stability, higher prices, not sell to china with trade war

**E. Budget**

Provide a detailed budget and justification using the Western SARE Budget Worksheet online.

ices, supplies, communication, travel, conference