FY 2026 New World Screwworm (NWS) Grand Challenge

I. GENERAL INFORMATION

Project Title

Prevention and Mitigation of NWS through Natural Phytochemical Enhanced Bovine Ration (NPEBR™)

Name of Organization Submitting the Proposal

Impact Fusion International, Inc (IFUS) in Cooperation with Deer Run (TX) & Walkabout Ranches (KS)

Total Funding Amount Requested

$1,122,769 U.S.

NWS Grand Challenge FY 2026 Priority Area

☐ Topic 1: Enhance sterile NWS fly production.

☐ Topic 2: Develop novel NWS traps and lures.

☐ Topic 3: Develop and increase understanding of NWS therapeutic/treatments (i.e. products that could treat, prevent, or control NWS) for animals and that could be stockpiled and used in animals should NWS reach the United States.

☒ Topic 4: Develop other tools to bolster preparedness or response to NWS.

Period of Performance

Start Date: 6/1/2026

End Date: 6/31/2027

Geographic Location

(1) IFUS, Napoleonville, LA (HUBZ-1 Location), (2) Deer Run Ranch, Jefferson, TX, (3) Walkabout Ranch, Anthony, KS, and (4) Oklahoma State University, Stillwater, OK (Best Choice due to proximity to test ranches, plus capability / And may be replaced by other equivalent academic institution).

Louisiana

Applicant Type

Please check the appropriate box

☐ non-domestic (non-U.S.) entity (foreign organization)

☐ non-domestic (non-U.S.) component of a U.S. organization

☒ Neither of the above is applicable

Species Used in the Proposed Project

1. New World Screwworms/NWS (Cochliomyia hominivorax), 2. Secondary Screwworm Fly (Cochliomyia macellaria), (3) Horn Flies (Haematobia irritans), 4. Face Flies (Musca autumnalis), 5. Stable Flies (Stomoxys calcitrans), 6. House Flies (Musca domestica), 7. Dung Bettles (Rollers (Geotrupes stercorarius), Tunnellers (Euoniticellus intermedius), Dwellers (Aphodius sordecen)), and 7. Mites (Acariformes and Parasitiformes). Species 6, 7, & 8 are crucial to understanding lignin content in manure, which is believed to be linked to production of beneficial phytochemicals with insecticidal and larvicidal properties.

Submitting Organization's Program Contact

Name: Marc Walther

Email Address: 'Impact Fusion Communications' <impactfusionintl@gmail.com>

Submitting Organization's Administrative Contact

Name: Rhonda Windsor

Email Address: 'Impact Fusion Communications' <impactfusionintl@gmail.com>

II. AWARD DESCRIPTION

NWS Mitigation through Natural Phytochemical Enhanced Bovine Ration (NPEBR™)
1. Purpose: A real-time and real-world pragmatic application of a modified ration applying ingredients high in natural phytochemicals (1) proven safe for bovine consumption, (2) known to mitigate and/or ameliorate fly populations, and (3) shown to improve eco-friendly, cost-effective, and sustainable herd performance. This ration strategy will be statistically validated and tested for defense against general fly populations to include NWS on two active ranches and a statistically controlled laboratory environment.
2. Activities to be performed: Ranchers (e.g., Walkabout Ranch, Kansas) state, "If we are talking about 'reduced fly populations', they are not reduced, but eliminated from herd population as long as you feed it!" Hence, testing of the ration will be conducted on active functional ranches, combined with university/private laboratory analysis.
3. Deliverables and expected outcomes: (A) Mitigation and/or amelioration of fly populations (to include the NWS) on respective ranching operations, while (B) improving herd performance in an eco-friendly, cost-effective, and sustainable manner.
4. Intended beneficiary(ies): Ranch Owner and Operator: Deer Run Ranch, Jefferson, TX: "The flies are gone…period…as is the smell in our pasture." Hence, if NPBER™ succeeds, like that which is being applied on the examples above, then Ranchers benefit from the mitigation and/or amelioration of flies (to include NWS) with improved Herd Performance in an eco-friendly, cost-effective, and sustainable manner.
5. Subrecipient activities: (1) OSU or university with equivalent capability: Data Correlation, (2) Deer Run Ranch, Jefferson, TX/Walkabout Ranch, Anthony, KS: Active Test Sites.
6. Summary: In consideration of the (1) highly evolved olfactory nature of the NWS, and (2) through reverse engineering attractants like Swormlure-5™, an alternative solution may be provided by (1) creating improved herd health, (2) reducing the frequency and severity of infectious injuries through mitigation of flies or other disease carriers, (3) reducing the frequency and concentration of VOC's said to attract the NWS, and (4) creating scents from beneficial phytochemicals emitted from the hides that repel the NWS. This could create a "Defensive-Shield" around beef and dairy cattle herds.

III. PROJECT OBJECTIVES, BACKGROUND, AND EXPECTED VALUE

Objectives:

Objective	*Amount*	*Objective Narrative*
Objective 1	$131,420	Validate Mitigation/Amelioration of General Fly Populations reducing Fly Management Costs and Damages (Cost Reductions) and supporting healthier herds (Revenue Increase)
Objective 2	$98,670	Determine Soil Amended Quality with NBEBR Modified Manure Pats to create (1) larvicidal activity against Fly Populations, (2) soil that may prevent NWS larval development, (3) reduce need for acid-based synthetic fertilizers from recycling of Humic Substances, and healthier, more plentiful grass with cost-savings. Per Deer Run Ranch, "… we stretch our grass a bit farther." Cost-Reductions/ Revenue Increases shown below.
Objective 3	$723,244	Determine decreased / increased NWS attraction to aged blood / meat samples from Cattle fed phytochemical modified Ration as compared to control group. Determine increase / decrease in VOC's, Putrescine, and Cadaverine.
Objective 4	$84,200	Track overall Herd Health/Performance as mitigation against Fly Populations and NWS. Apply pragmatic tools used by real-time ranching operations like Deer Run Ranch and Walkabout Ranch. Perform Carcass Analysis and Autopsy on 4-random selected steers along with Herd Scoring and other established Best Practice Herd Performance Criteria (presented in grant below). Supports decreased costs/increased revenues/
Objective 5	$178,024	Track shift in Manure Scoring, Pasture Odors, etc. indicative of sustainable mitigation of the Fly Populations and NWS through improved Herd Performance.

Background and Significance

Offering a "piggy-back" to a University Controlled Statistical Trial (see SUAREC Multi-Modal IoT Monitoring of White Rot Fungi Treated Lignocellulosic Biomass for Enhanced Beef Cattle Performance) and mirrored by Real-World Working Ranching Operations (Deer Run Ranch, Jefferson, TX and Walkabout Ranch, Anthony, KS), we contend that further testing is warranted into the "Prevention and Mitigation of NWS through Natural Phytochemical Enhanced Bovine Ration. (NPEBR)."

In support of this are Testimonies based on Trials conducted by several ranchers in the U.S.:
1. Ranch Owner and Operator: Walkabout Ranch, Kansas: "If we are talking about 'reduced fly populations', they are not reduced, but eliminated from herd population as long as you feed it!"
2. Ranch Owner and Operator: Deer Run Ranch, Jefferson, TX: "The flies are gone…period…as is the smell in our pasture."
3. When Dr. Pat Bagley and Dr. Mallory Tate, DVM visited Deer Run Ranch, TX, they noted the lack of flies. They admitted they were skeptical. Then, they searched for fly treatment and found none.
4. Additionally, other ranchers report that fly populations decrease and/or are completely eliminated.

- These claims are supported by pictures like that below showing a Heifer with calf after feeding a NPBER™ containing SGP+™ for about 3-months.

5. Please note, where there are a few flies on the face of the heifer above, the rancher reports a significant reduction as well as an overall elimination on the hide of the cow.

5a. Deer Run Ranch reported improvements were noted within a couple of weeks. Yet, it took about 6-months of SGP+™ supplementation to their respective Ration Management Strategy before their fly problem was eliminated and their Herd Performance reached steady-state.

5b. Additionally, the rancher in Louisiana also reported that there are no flies on the manure pats or eggs/larvae found within the Score 3 pats being produced.

6. Furthermore, pictures cannot be provided for reported lack of the normal pasture smell when beef herds are present. Rather, what ranchers are reporting is that their pastures begin to smell of fresh earth, woodsy, and spicy scents. Of interest is that the active natural ingredients in the SGP+™ (used in NPEBR™) are known to produce a phytochemical (Beta-Caryophyllene), which is coincidentally noted as producing a "woodsy, strong, spicy" smell. Beta-Caryophyllene is also noted to not only be a beneficial phytochemical, but also an insect repellent.

7. Ranchers believe that they have discovered a way to protect their respective herds from the NWS. Hence, (1) they have asked why this is possible, and (2) how they might replicate the success.

Hence, an extensive literature review has been undertaken to find plausible support for these claims. Samples of such studies are provided below (with more comprehensive studies found in White Papers on the IFUS website at https://www.impactfusionbrands.com/):

1. Justification: (A.) "Larvicidal Activity of Selected Plant Extracts Against the Screwworm Fly *Chrysomya Albiceps*," (M..M. Al-Jameeli, Larvicidal, Biosci Biotech Res Asia 2021;18(3)). Plant compounds, beneficial to bovine health, also produce natural phytochemicals reported to have dramatic effects on preventing biting flies and other predacious insects (to include the New World Screwworm Fly): (1) from being attracted to beef and dairy cattle, (2) from wanting to bite the cow (3) to discouraging the fly to lay her eggs into the cow, and (4) to preventing the larvae from becoming a mature fly.

(B.) Furthermore, in the study "Health-Promoting Phytonutrients Are Higher in Grass-Fed Meat and Milk," (S. van Vlie, et.al., (2021). Frontiers in Sustainable Food Systems. 4. 555426. 10.3389/fsufs.2020.555426.), "Emerging data indicate that when livestock are eating a diverse array of plants on pasture, additional health-promoting phytonutrients—terpenoids, phenols, carotenoids, and anti-oxidants—become concentrated in their meat and milk." Ranchers believe that SGP+™ enhanced NPEBR™ is supporting this.

(C.) Hence, the inter-relations between ration fed, digestibility, and absorbability affect the manure and emissions of a variety of VOC's (many of which are said to attract flies within seconds from quite some distance away.) VOC's are quite relevant to the NWS. In consideration of the highly refined nature of the olfactory capabilities of the NWS, a deeper exploration into a bovine ration management program that naturally repels the NWS is warranted and supported by: (1) "Screwworm females are attracted to wounds that may be as small as those caused by the feeding of the invasive cattle tick *Rhipicephalus* (*Boophilus*) *microplus*" (OIE, World Organisation for Animal Health, 2013), which has periodic outbreaks in Mexico and south Texas (Pérez de León et al., 2012) and (2) "It is suggested that the olfactory senses of a Screwworm Fly (like most flies damaging bovine herds) are as highly evolved as any insect encountered on Earth." (Gutierrez AP, et.al., Deconstructing the eradication of new world screwworm in North America: retrospective analysis and climate warming effects. Med Vet Entomol. 2019 Jun;33(2):282-295.

(D.) Active ingredients containing natural phytochemicals (e.g., Carob (*Ceratonia siliqua*), Chios Mastic Gum (*Pistacius lenticus)*, and pre-treated Sugarcane Bagasse) exhibit natural insecticidal and wound healing properties:

(D-1). "*Ceratonia siliqua* (carob) contains insecticidal triterpenoids. Research has shown that the methanol extracts from the plant exhibit significant insecticidal activity against mosquito larvae and housefly larvae." ("Study of the effect of dryness and storage on Ceratonia siliqua L. stem extracts and evaluation of their insecticidal activity," Esraa A. Elhawary, et.al., Scientific Reports, Volume 15, Article number: 11123 (2025))

(D-2). The same can be said for Chios Mastic Gum: "Research has shown that the fruit extract of *Pistacia lentiscus* is toxic to the larvae of the grapevine moth, *Lobesia botrana*, indicating its potential as an insecticide. Additionally, the essential oil from this plant has been found to exhibit acaricidal effects against red poultry mites, *Dermanyssus gallinae*, suggesting its effectiveness in controlling certain insect pests (1,2)

Ref. (1) Insecticidal Effect of *Pistacia lentiscus* (*Anacardiaceae*) Metabolites against *Lobesia botrana* (*Lepidoptera: Tortricidae*), Ioanna Dasenak, et.al, Agronomy 2022, 12(4), 755

Ref. (2) *Pistacia lentiscus* essential oil and its pure active components as acaricides to control *Dermanyssus gallinae* (Acari: Mesostigmata), Dhouha Alimi, et.al., Veterinary Parasitology, Volume 322, October 2023, 110028

(D-3). "White rot fungi can enhance the nutritional value of sugarcane bagasse (SCB) for cows by improving its digestibility and protein content. Studies have shown that treating SCB with specific white rot fungi, such as *C. indica*, can increase crude protein content by up to 104.1% and improve digestibility by 38.8%" (N.A. BagasseKhan, et.al., "Biotechnological Processing of Sugarcane Bagasse through Solid-State Fermentation with White Rot Fungi into Nutritionally Rich and Digestible Ruminant Feed." Fermentation 2024, 10, 181.)

2. What phytochemicals might prevent the NWS from biting the cow?

2a. As one of several examples, B-caryophyllene: "The chemical in *Pistacia lentiscus* that repels insects is β-caryophyllene, which is the most effective component of its essential oil. This essential oil has shown high repellent activity against various insect pests, making it a potential eco-friendly alternative to chemical repellents." (*Pistacia lentiscus* essential oil has repellent effect against three major insect pests of pasta, Hind Houria Bougherra, et.al., Industrial Crops and Products, Volume 63, January 2015, Pages 249-255)

2a.1: "Also, as wound prevention, rapid wound healing reduces VOC's and other odorants produced from wounds". (Koyama S, et.al., "Beta-caryophyllene enhances wound healing through multiple routes." PLoS One. 2019 Dec 16;14(12):e0216104. doi: 10.1371/journal.pone.0216104.)

3. Discourage the NWS to lay her eggs into the cow

3a. "Screwworm larvae survival depends on proper host selection made by the mothers, which prefer to lay eggs on dry borders of animal wounds and bodily orifices (46). This decision prevents the embryos from drowning in body fluids while ensuring hatching larvae immediate access to a nutrient-rich environment. Newborn larvae might use olfactory cues to guide their way from the oviposition site into the substrate to feed. Once the feeding source is found, this olfactory-based orientation might be gradually replaced by contact chemoreception, such as gustatory, explaining the decrease in ChomOrco expression during subsequent larval stages."

Ref.(46): Thomas DB, Mangan RL. Oviposition and wound-visiting behavior of the screwworm fly, *Cochliomyia hominivorax* (*Diptera: Calliphoridae*) Ann. Entomol. Soc. Am. 1989;82:526–534.

3b. Of note is "A similar pattern is observed in other blowflies, such as *Lucilia sericata* (49) and *C. megacephala* (Fig. 2C), indicating that the modulation of Orco expression is also evolutionary conserved. Interestingly, food ingestion by *D. melanogaster* is enhanced in the presence of microorganism-derived odors (50). Thus, a reduction in olfactory input might be related to the lower rates of larval survival observed for the Orco mutant strain developed in this study."

Ref. (49): Wang X, et al., "Molecular characterization and expression pattern of an odorant receptor from the myiasis-causing blowfly, *Lucilia sericata* (*Diptera: Calliphoridae*", Parasitol. Res. 2012;110:843–851.

Ref. (50): A. Depetris-Chauvin, et.al., "Olfactory detection of a bacterial short-chain fatty acid acts as an orexigenic signal in *Drosophila melanogaster* larvae". Sci. Rep. 2017;7:14230.

3b-1. From the aforementioned science, one could plausibly entertain that if natural phytochemicals create odors and/or tastes repellant to the NWS Larvae, then the larvae would expend its energy searching for nutrition without finding it; hence, would weaken and die.

3c. Cadaverine is one of the chemicals produced from wounds in the bovine hide, and creates odor(s) said to attract the NWS. We find that: "Gallic acid (GA) does reduce cadaverine levels in the body. It regulates amino acid metabolism by suppressing the synthesis of cadaverine and enhancing its degradation, which ultimately leads to a reduction in cadaverine levels. "The metabolic regulation mechanism of gallic acid on biogenic amines and nitrosamines in reduced-nitrite Chinese fermented sausages: A perspective of metabolomics and metagenomics," Qin Zhou, et.al., Food Chemistry, Volume 456, 30 October 2024, 139900

3d: Another odorant that attracts NWS is said to be Putrescine. "Gallic acid has a significant effect on putrescine production. It was found that putrescine formation from agmatine diminished in the presence of gallic acid, indicating that gallic acid can inhibit putrescine synthesis. Additionally, putrescine levels rise within hours after acidification, suggesting a direct relationship between gallic acid and putrescine levels. Therefore, gallic acid may play a role in regulating putrescine production in certain contexts. (1, 2)"

Ref. (1) "Putrescine production from agmatine by *Lactobacillus hilgardii*: Effect of phenolic compounds," María R. Alberto, et.al., Food Control, Volume 18, Issue 8, August 2007, Pages 898-903, https://doi.org/10.1016/j.foodcont.2006.05.006

Ref. (2): "Apoptosis is one of the natural biological processes of programmed and controlled destruction of own cells in the multi-cellular organism. This mechanism is needed and affects the proper development, homeostasis, and prevention of excessive, harmful multiplication of body cells. It can be induced by

various stimuli and common signalling mediators [69], such as 6-hydroxydopamine or reactive oxygen species (ROS). As reported in [70], GA exhibits dose-dependent anti-apoptotic properties as it prevents the 6-hydroxydopamine-induced apoptosis (through its auto-oxidation) of dopaminergic cells. The cited paper also showed that the compound affects intracellular glutathione levels, ROS production, and Ca2+ influx, which independently indicates a protective effect of GA against apoptosis." A Concise Profile of Gallic Acid—From Its Natural Sources through Biological Properties and Chemical Methods of Determination, Dorota Wianowska, et.al., Molecules. 2023 Jan 25;28(3):1186.

4. Prevent the NWS larvae from becoming a mature fly.
4a. Furthermore, "Gallic acid can impair the growth of insect larvae without causing significant harm to their parasitoid wasps." ("Effect of gallic acid on the larvae of *Spodoptera litura* and its parasitoid *Bracon hebetor*," Abhay Punia, et.al., Sci Rep. 2021 Jan 12;11:531.
4b. The larvicidal nature of Gallic Acid found in Carob and Mastic (and produced by depolymerized lignin from Sugarcane Bagasse) represents another layer of fascinating biochemistry. However, at the very least, serious consideration and deeper scientific exploration is worthy into synergies provided by Nature to produce an eco-friendly, cost-effective, and sustainable solution that addresses the "Root Cause" to both the greater fly problem as well as the NWS through enhanced Bovine Herd Performance. Of course, results prove a point…that is, (1) a lack of flies on the herds and the manure, (2) as well as lack of fly eggs and larvae in the manure.

Both of the ranchers (along with other experts in beef) repeat a Mantra: Fix the Ration…Fix the Gut! Fix the Gut…Fix the Cow! Fly-free, disease-free, healthier herds that replenish the land are also highlighted. Of course, this has to be accomplished cost-effectively with added benefits of being eco-friendly and sustainable so as to create profit. Provided below is an example as to how one rancher is achieving this.

Further Testimonial Evidence Resulting from Trials: As noted above, Deer Run Ranch successfully applied SGP+™ as part of its NPEBR™ to its herds for nearly 12 years now. Here's information from an active member of the ranch: "As a 7th Generation Rancher and the son of the present owners of Deer Run Ranch, we have a simple motto: Keep the business going for the next generation by making a profit and honoring our family, the land, and the herd. We purchase on average Score 1 cattle of various breeds and transform these into Score 5-6 cattle. With Score 5-6 we find best economic outcomes. Our costs are governed by what we feed, how feed, how long we feed and the like. It is a very simple business model that 'Scores' the cattle were going to sell (bulls, steers, calves, and heifers) so that they fetch the highest price at auction. Since our operation has utilized SGP+™ as part of our NPEBR™, achieving these goals have become more practical and easier. Our herds outperform herds like ours, and in shorten time periods. We fetch higher prices on the parts of the herd we sell, while significantly reducing our costs…feed, water, antibiotics, fly protection, minerals, and more…and we stretch our grass a bit farther. Our herds are healthier. Our baby calves rarely die and gain weight and finish fast. Our pastures and cattle are for the most part fly free. Our pastures have no smell other than fresh, spicy, and woodsy earth. What is most noticeable to us is that when SGP+™ supplies have been disrupted, our herd performance decreases rapidly, our costs go up, and our profits go down…and the flies reappear. It's as simple as that."

Deer Run Ranch mirrored the work done at Walkabout Ranch along the Oklahoma / Kansas border. The conditions in NE East Texas are very different. Yet, they found similar results when they placed their data into a SGP+™/NPEBR™ Economic Case Study. They are a grass-fed operation, and typically supplement SGP+™/Cracked Corn at roughly an 85/15 ratio, respectively. Like most ranches, their ration is governed by availability and costs.

"1. Executive Summary: Deer Run Ranch is a working 'test ranch' operating as a real-world proving ground for improved cattle nutrition, reproductive efficiency, and profitability. While not yet formally affiliated with a university, the ranch operates using animal science–based management practices and is positioned to support future academic research partnerships."

Here are excerpts from the Deer Run Ranch, Jefferson, TX "Rancher & Investor Overview". The Ration Management Strategy being applied at Deer Run Ranch:

- **Reduces total supplementation complexity and cost**
- **Improves average daily gain (ADG) of calves**

- **Improves cow body condition and reproductive traits**
- **Increases calf crop percentage**
- **Produces a **2.25× return on feed investment** under conservative assumptions**
- **Eliminates the need for (1) Separate mineral programs, (2) Fly control supplements, (3) Foot rot & pinkeye supplements and other antibiotics, and (4) Protein supplements**

Net annual input savings: ~$74 per cow versus conventional inputs

Performance Improvements (Conservative Assumptions)

Baseline Performance

- Average weaning weight: 487 lb with Normal calf crop: 95%

SGP+™ Performance

- **(1) Increased milk production & quality, (2) Improved nutrient absorption from grass, and (3) Improved cow body condition & estrus expression**

Conservative gains used in this model:

- (1) +0.75 lb/day ADG over 240 days, (2) Resulting weaning weight: 667 lb, and (3) Improved calf crop: 98% (+3%)

ROI Summary

(1) Annual Ration cost: $146 per cow, (2) Total return: $344 per cow, and (3) ROI: ** ~2.25×**

Deer Run Ranch (like Walkabout Ranch, KS) insists they have developed an eco-friendly, cost-effective, and sustainable model, not only for their respective ranching operations, but one that mitigates (if not ameliorates) the potentially catastrophic effects of the NWS within their operations. The application of SGP+™ as part of their "Natural Phytochemical Enhanced Bovine Ration" is what **they believe** is making them successful.

Trials conducted in the U.S. demonstrated reduced/eliminated fly populations on beef cattle when fed a modified ration of Carob, Chios Mastic Gum, and Ionic Minerals applied to Sugarcane Bagasse (SB). WRF seemingly depolymerized recalcitrant lignin both *in vitro* and *in vivo,* producing additional beneficial phytochemicals for bovine herd performance. In this lay what the science is telling us are phyto-protective properties to include defense against the NWS.

Expected Impact and Value:

Ranchers and dairymen who have modified their respective ration to include Chios Mastic Gum, Carob, and Minerals added to Sugarcane Bagasse (SGP+™) and applied as NPEBR™, report the following synergies:

- Reduced/Eliminated Fly/Insect Infestations.
- Higher Quality/Quantity Meat, Milk, and Colostrum.
- Reduced Infant Mortality and Miscarriages with Higher Quality Calves.
- Reduced Antibiotic Application/Improved Herd Health.
- Reduced Costs, Higher Revenues, and Higher Profits.
- Improved Manure Quality for Natural Replenishment of Top Soil.
- Improved Heat Tolerance
- Reduced Hydration Requirements.
- Reduced Greenhouse Gases/Carbon Footprint.

In summary: (1) Lowered costs, (2) Improved herd performance/quality, (3) Increased revenues/profits, and (4) Reduced Carbon-Footprint.

Here is an example of a specific report of "Impacts and Value" from Walkabout Ranch, KS:

Trial 1: The Walkabout Ranch, KS concluded that “SGP+™ pays you back ~ 2.25 times the cost of feeding it!"

- For over 2-years now, several Angus herds managed on ranchlands along the Oklahoma-Kansas border have been managed by a "Care Taker" Ranching Operation. Of recent a blind trial was conducted on a herd of 92-Angus and 2-sets of 25-Cow Custom grazing groups.

- The rancher in charge of these herds and performing the trials has an ANSI (Animal Science Production Degree) from the Oklahoma State University. After completing these trials and moving into the implementation of SGP+™ as part of his newly established Ration Management and Herd Performance Strategy (NPEBR™), he writes: "I did some figuring on practical economics in real time. Seems SGP+™ can truly be an economic game changer in the real-world argument of reducing cost and increased profit. Below you will find examples of cow costs in my area, along with the benefit of SGP+™ fed by care takers (ranchers who pasture other people's cattle).
- "Cow costs of normal expenses and ADG of calves to weaning per year.
  - Example based on 15 acres of grass per year per cow unit.
    Rents per acre examples
    $15 x 15 =$225.00
    $20 x 15=$300.00
    $25 x 15 =$375.00
  - Cost of production inputs Per cow.
    - Mineral - fly protection foot-rot protection pinkeye protection = $60
    - Protein = $280/ ton @ 3#/ day for 150 days = $65
    - Hay = $65
    - Total = $190
  - Average weight of weaned calf (1/2 male / 1/2 female @ 240 days).
    - 487# = $230
  - Conventional cow cost with rent.
    - 225 + 190 =415
    - 300+ 190 =490
    - 375 + 190=565
  - SGP+™ / alfalfa ration fed daily @ 5#/day.
  - **SGP+™ Eliminates all other mineral, fly, foot rot, pinkeye, protein or other supplements or feed.**
  - Cost of SGP fed @ 5# ration = $.40/day or $146/ year.
    - Saving $46 per year
  - **Increasing ADG (Average Daily Gain or ADWG Average Daily Weight Gain) by increasing milk production and quality of milk. Cow/calf absorption of nutrients in grass increase all reproductive traits and lead to increased body score of cow and increased length of estrus. Providing increased chance of more calves sold**. We'll use 3% more calves, for example:
    - Based on 95% normal calf crop. Or 98% of price of calves. 1/2 male. 1/2 female
      - With an increased ADG of .75#/ day. @240 days.
      - 487# calf = $2,480 x 95% =$2,356.00 per head
    - SGP fed calves:
      - 667# calf = $2,680 x 98%=$2,626.40 per head
    - **A gain of $270 per cow**
    - **Add in pasture cost savings = $326 per cow**
      - $415-326=$89.00
      - $490-326=$164.00
      - $565-326=$239.00
  - **SGP+™ pays you back ~ 2.25 times the cost of feeding it!** Based on the steers we slaughter for personal consumption, SGP+™ produces more pounds of total beef quicker, allowing less time on feed at the feedlot…and creates a faster farm to table realization. Also, the meat produced birth to plate will make U.S.D.A. Prime Beef extremely desirable in the export market."
  - The rancher adds in additional e-mails to IFUS: "So, I took the price of a steer and a heifer at those weights and averaged them. Hence, 1/2 male/ 1/2 female.
  - **All figures are conservative.** Mineral fly protection for some will be much higher.
  - **But for argument… Assuming that all herds are kept on grass year-round. The SGP+™ ration is 2.5# SGP+™ and 2.5# alfalfa. Gets cost in our location to $0.40 / day."** This rancher (along with others) is suggesting that the **hydration requirements for the cattle herds is being reduced around of 30%.**

- Additionally, this rancher has provided additional information whereby he writes: "SGP+™ reduces drought impact on pastures, reduces grass intake by 25%, decreases the need for grass fertilizers, and reduces animal water intake." He has also provided data in earlier communications as to the specific impact of reduced water requirements on the ability of farmers to have added water. “If every feedlot (cattle on feed report #) were feeding SGP+™, the amount of water saved would offset the amount of water needed to produce the pounds of corn used for the total amount of cattle by almost 79%. 12 million gallons a day equal 70 circles of corn at 125 acres per circle and 200 bushel per acre.”
- SGP+™ is **not** just an add-on product, but part of an "Outcome-based Ration Management Strategy" applied with pragmatic discipline…one based on a NPEBR™ and Herd Management Best Practices so as to achieve eco-friendly, cost-effective, and sustainable Herd Performance.

Trial 2: Calculations based on extrapolated data and results from Deer Run Ranch’s, TX operation resulted in a similar validation that “SGP+™ pays you back ~ 2.25 times the cost of feeding it!"

- At Deer Run Ranch the business model is simple: A Cow-Calf operation, where Purchased Score 1 as well as calves generated are transformed into Score 4 to 5. Please note Scoring is highly breed dependent. A Score 4 Angus may present itself differently than a Score 4 Longhorn.
- Deer Run Ranch reports that it has **eliminated fly control** products (as long as the herd is managed with SGP+™ as a part of a NPEBR™). Flies return to the herd and manure when the herd is removed from SGP+™NPEBR™. Pictorial evidence is offered below of cattle at Deer Run Ranch, TX:

Relationship to Other Projects

Project Title: Multi-Modal IoT Monitoring of White Rot Fungi Treated Lignocellulosic Biomass for Enhanced Beef Cattle Performance **NOTE: This particular study is part of a series of studies either underway or in proposal stage. NONE of these studies are linked to NWS Challenge proposal funding. However, the data from this study (as well as the others) will be used to (1) better understand Natural Phytochemical Enhanced Bovine Ration and (2) further substantiate the reports resulting from Trials to date (as well as the proposed study), as the ingredients will be supplied by IFUS and applied as part of SUAREC's Ration Management for their respective purposes. IFUS seeks independent scrutiny (e.g., Blind Trials outside of IFUS control) of its products/technologies.**

Project Type: Evans-Allen (Capacity)

Performing Institution: Southern University Agricultural Research and Extension Center (AgCenter)

Lead Investigator (PD/PI): Dr. Mallory K. Tate

Primary Performance Site: Baton Rouge, Louisiana (Southern University AgCenter beef unit)

1) Non-Technical Summary (Public Facing): Louisiana produces large volumes of sugarcane bagasse, but its high lignin content limits its value as cattle feed. This project tests whether treating bagasse with white rot fungi (Pleurotus ostreatus) can reduce lignin and improve fiber digestibility, allowing producers to convert local agricultural byproducts into improved beef performance. To objectively measure animal response without frequent handling, we will deploy a smart ranching monitoring system that combines ingestible e-bolus sensors for internal rumen health, artificial intelligence cameras to observe feeding behavior, and walk-over scales at water access points to capture frequent weight measurements. The results will provide practical evidence on whether white rot fungi treated bagasse can support growth and rumen stability while using low-stress, automated monitoring that is feasible for small and mid-size Gulf South operations.

2) Goals and Objectives (REEport Objectives):

Overall Goal: Develop and validate an Evans-Allen capacity-ready, data-driven feeding and monitoring system to determine whether white rot fungi treated sugarcane bagasse improves rumen function and growth performance in beef cattle under Louisiana conditions.

- Objective 1: Biochemical transformation of lignocellulosic biomass

Quantify lignin reduction and fiber changes in sugarcane bagasse following white rot fungi inoculation and controlled incubation.

- Objective 2: Internal metabolic mapping using LoRaWAN e-boluses

Monitor rumen pH, temperature, rumination kinetics, activity, and water intake continuously and compare physiologic stability between treated and untreated bagasse diets.

- Objective 3: Behavioral analysis via AI vision at the feed bunk

Quantify time-on-feed, feeding bout frequency, and preference patterns for treated versus untreated bagasse using edge AI computer vision.

- Objective 4 Autonomous growth tracking with walk-over weighing

Capture high-frequency body weight trajectories at water access using walk-over scales and relate growth curves to diet treatment and physiologic and behavioral signatures.

- Objective 5 Data fusion and digital twin development

Synchronize time-stamped physiology, behavior, and growth data streams to create animal-level integrated performance profiles suitable for extension demonstration and future research scaling.

3) Approach and Methods (REEport Approach)

Experimental design:

A controlled feeding trial with 12 beef cattle assigned to two groups: untreated bagasse control (n=6) and white rot fungi treated bagasse (n=6). Cattle will be managed under standardized husbandry and water access while diets differ by treatment. The trial will be structured to allow repeated measures across time, enabling within-animal trend analysis.

Feed treatment and verification:

Sugarcane bagasse will be inoculated with Pleurotus ostreatus under controlled moisture, aeration, and incubation time. Pre- and post-treatment samples will be analyzed for lignin reduction and fiber profile to verify biochemical transformation before feeding.

Multi-modal IoT monitoring system:

•Physiology layer: ingestible e-bolus sensors capturing pH, temperature, rumination kinetics, activity, and water intake transmitted to a LoRaWAN gateway for time-stamped logging.
• Behavior layer: edge AI cameras positioned at feed bunks using computer vision models to estimate time-on-feed and feeding bout frequency while minimizing manual scoring.
• Performance layer: walk-over scales installed at water access points to collect frequent weight measurements with minimal handling.
Data integration and analytics:
All three data streams will be time-synchronized and merged into a unified dataset to generate daily and weekly summaries, detect deviations, and evaluate treatment effects on rumen stability, feeding behavior, and growth. Outcomes will be analyzed using repeated-measures statistical models comparing treatment groups over time.
Unique aspects and departures from usual methods:
Unlike conventional feeding trials relying on periodic weigh-ins and limited spot checks, this study produces a continuous, low-stress evidence stream by integrating internal biotelemetry, automated behavior sensing, and frequent passive weighing. The fused dataset supports animal-level digital twin style performance profiling.

4) Products and Deliverables (REEport Products)

• Verified white rot fungi bagasse treatment protocol and lab verification dataset (lignin and fiber profile)
• Time-synchronized multi-modal dataset linking rumen physiology, feeding behavior, and high-frequency weight curves
• Producer-ready monitoring workflow and standard operating procedures for low-stress data collection
• Extension demonstration materials and decision support summaries for Louisiana producers
• Peer-reviewed manuscript submission and technical presentation outputs aligned with Evans-Allen capacity outcomes

5) Outcomes and Impacts (REEport Outcomes)

• Evidence on whether white rot fungi treated bagasse improves rumen stability and growth performance relative to untreated bagasse
• Reduced reliance on animal handling for monitoring, supporting higher welfare research and producer adoption
• A scalable smart ranching monitoring blueprint for 1890 Land-Grant institutions and small producers using locally available byproducts
• Strengthened Evans-Allen research capacity at Southern University through integrated IoT, AI, and nutrition evaluation

6) Target Audience (REEport Target Audience)

Small and mid-size Louisiana beef producers, 1890 Land-Grant agricultural technology researchers, veterinary students, and animal science or ag-tech undergraduates at Southern University.

7) Keywords (REEport Keywords)

Sugarcane bagasse, white rot fungi, Pleurotus ostreatus, lignin reduction, fiber digestibility, beef cattle, rumen pH, e-bolus, LoRaWAN, AI vision, computer vision, walk-over scale, precision livestock farming, smart ranching, digital twin

REEport Classifications (Totals Required)

Knowledge Area (must total 100%)

- KA 307 Animal Management Systems: 40%
- KA 302 Nutrient Utilization in Animals: 30%
- KA 402 Engineering Systems and Equipment: 30%

Total: 100%

Subject of Investigation (must total 100%)

- SOI 3310 Beef Cattle Live Animal: 100%

Total: 100%

Field of Science (must total 100%)

- FOS 2020 Engineering IoT AI: 50%
- FOS 1010 Nutrition and Metabolism: 50%

Total: 100%

IV. APPROACH

Deliverables and Outcomes

Objectives	Deliverables and Outcomes: Note: Line-Item Detail Found in Financial Template
Objective 1	Validate Mitigation and Amelioration of General Fly Populations (to include NWS)
1.1	Photographic and Video evidence with tabular fly population data on Cattle at Deer Run and Walkabout Ranches. (On-going videos, 6-sets of photographs with 1 set at project kickoff and sets taken every 45-days for 1 year, plus 8-physical visits to confirm video data.)
1.2	Photographic and Video evidence with tabular fly population data on Deer Run & Walkabout Ranches removed from Fly Control Ration vs. weekly progression when reintroduced to ration.
Objective 2	Determine Soil Amended with Ration Modified Manure Pats larvicidal activity against General Fly Populations and NWS
2.1	Soil Analysis for phytochemicals repellant to General Fly Populations (and NWS).
2.2	Photographic and Video evidence with tabular fly egg/larvae population data on Deer Run & Walkabout Ranches removed from Fly Control Ration vs. weekly progression when reintroduced to ration
Objective 3	Determine decreased NWS attraction to blood samples from Cattle fed phytochemical modified Ration compared to Standard
3.1	Meat / Organ Quality Carcass Analysis, Animal Health/Carcass Autopsy, Phytochemical/VOC Lab Analysis on Carcass Fluids, Hide and Flesh.
Objective 4	Track overall Herd Health and Performance as mitigation against General Fly Populations and NWS
4.1	Herd Scoring, Herd Health Analysis, Ranching Practices
Objective 5	Track shift in Herd Scoring, Manure Scoring and Analysis, Forage Analysis, and Pasture Odors indicative of sustainable mitigation of General Fly Populations and the NWS through improved Herd Performance
5.1	Establish Standard Baselines and test the progression from Baseline, to SGP+™, to NPEBR™ for respective ranch, to manure, to soil. For example, what happens through the progression (Value Chain) to (a) lignin concentration, (b) Humic Substances, (c) mineral concentration, (d) Crude Protein and other nutritional factors, (e) fly populations, (f) and other established standard data points. Apply 6-Sigma methodology to create (1) Scatter Plots, (2) Affinity Diagrams, (3) Fishbone Diagrams, (4) SPC, (5) Histograms, (6) Value Stream Maps, and (7) other tools where appropriate to individual, collective, and overlayed analysis.

Activities/Methods

Objectives	Activities/Methods (Note 1: ALL DATA AND REPORTS REMITTED TO OSU (or equivalent university for compilation, review, commentary, and submission for peer review. Note 2: Line-Item Detail provided in Financial Template)	Start Date	End Date
Objective 1	Validate Mitigation and Amelioration of General Fly Populations though (1) video monitoring, (2) physical visits by Entomologist (3) perform Fly Population and Classification, (4) review data, reconcile to analytics, prepared and submit report/visit, (5) Final report due 31Jun27. NWS Biosafety protocols required.	1Jun27	31Jun27
1.1	Deer Run Ranch, TX/Walkabout Ranch, KS Fly Assessment, Herd Assessment, Ration Assessment, Manure Assessment, Start Day-1 repeated every 45-days until 31May27.	1Jun26	31Jun27
Objective 2	Determine Soil Amended with Ration Modified Manure Pats larvicidal activity against NWS though (1) Soil Sampling, (2) Soil/Land Survey, (3) physical visit by Soil Scientist.	1Jun26	31Jun27

2.1	Deer Run Ranch, TX/Walkabout Ranch,KS Soil & Manure Assessment, Start Day-1 repeated every 45-days until 31May27. (1) Submit Report / visit with Final Report compiled and remitted by 31Jun27.	1Jun26	31Jun27
Objective 3	Determine decreased NWS attraction to blood samples from Cattle fed phytochemical modified Ration.	1Dec26 & 31May27	1Dec26 & 31May27
3.1	1-Steer from Deer Run Ranch and 1-Steer from Walkabout Ranch will be selected by visiting team under leadership of DVM. Each will be shipped to common qualified facility for slaughter followed by Comprehensive Carcass Analysis as well as Carcass Autopsy. This will happen at 6-months into Trial and again at 12-months.	1Dec26 & 31May27	1Dec26 & 31May27
3.2	Carcass Analysis / Carcass Autopsy / Tissue and Fluid Analysis Coordinated with NWS Trials on Hide, Tissue and Blood Samples (managed by lab with ALL necessary biosafety requirements)	1Dec26 & 31May27	22Dec26 / 22Jun27
3.3	DVM visits and assessment Start Day-1 repeated every 45-days until 31May27. Reports / visit with Final report due 31Jun27.	1Jun26	31Jun27
Objective 4	Track overall Herd Health and Performance as mitigation against NWS Start Day-1 repeated every 45-days until 31May27. Final report due 31Jun27.	1Jun26	31Jun27
4.1	Deer Run Ranch, TX/Walkabout Ranch, KS Soil & Manure Assessment, Start Day-1 repeated every 45-days until 31May27. (1) Herd Body Scoring, (2) Colostrum / Milk Eval., (3) General Ranching Practice Survey, (4) Fly Validation, (5) Physical Visit by Animal Science, Data Collection, Data Analysis, Reporting. Final Report due 31Jun27.	1Jun26	31Jun27
Objective 5	Deer Run Ranch, TX/Walkabout Ranch, KS Soil & Manure Assessment, Start Day-1 repeated every 45-days until 31May27.	1Jun26	31Jun27
5.1	Track shift in Manure Scoring, Pasture Odors, etc. indicative of sustainable mitigation of the NWS through improved Herd Performance. (1) Samples collected by respective SME, (2) Samples shipped & handled by SME, (3) Analysis conducted at respective qualified lab,	1Jun26	31Jun27

Additional Contributors:

Name, Title, Organization	Contribution to the Project
OSU or Equivalent Institution	Data Correlation, Summary Analysis, Reporting, Peer Review Submission, Public Facing Distribution
DVM	Herd Health Assessments & Carcass Autopsy
Animal Scientist / Entomologist	Herd Health, Manure and Soil Sampling and Reporting,
Entomologist	Fly, Insect, Pest tracking. Testing of Meat Samples to Repel NWS
Cumberland Valley Analytical Services / Other Analytical	Forage and Manure Analysis
Soil Analysis Lab / OSU Ext. Service	Soil Analysis
Deer Run Ranch	Herd Performance Trials
Walkabout Ranch	Herd Performance Trials

Consultation:

(1) U.S.D.A. Regional Offices, (2) Local Agricultural Extension Services, (3) Regional or National Universities, (4) American Sugarcane League, (5) Other Ranchers / Dairymen, (6) National Cattlemen's Beef Association.

Need for Subject Matter Experts

Describe any support needed from subject matter experts and who the subject matter experts are.

1. DVM (Large Animal / Beef Specialist)
2. Animal Scientist (Large Animal Beef Specialist)
3. Entomologist (Large Animal Beef / Fly Specialist, specifically NWS)
4. Practicing Rancher / Joe Wilcox
5. Practicing Rancher / Deer Run Ranch

Project Evaluation:

Objectives	Quantitative (Measurable) and Qualitative Methods and Criteria that will be Used to Evaluate Successful Completion of Each Objective and the Overall Project:
Objective 1	Bottom Line: Mitigate and/or Ameliorate General Fly Populations to include the NWS. Pictures and Videos of Deer Run Ranch and Walkabout Ranch Herds to evaluate fly densities and species. Continuous video observations with SME visits Day 1 and continuing every 45-days until project completion to substantiate findings, followed by peer review.
Objective 2	Do the Manure Pats produced by the herds (fed a Natural Phytochemical Enhanced Bovine Ration) improve the soil conditions? A. Soil-Analysis Prior to Supplementation Day 1, and every 45-days until project completion. Soil analysis to include: (1) Soil pH, (2) Lime index (lime buffer capacity), (3) Available P, K, Mg, and Ca as pounds/acre, (4) Estimated soil cation exchange capacity (CEC) at the target pH management level, (5) Percent saturation of the soil CEC with K, Mg, Ca, and acidity (nutrient balance), (6) Percent organic matter, (7) Available Zn as parts per million on applicable crops, (8) Exchangeable Na, total soluble salts, nitrate-N where requested, (9) Humic Substance Analysis, (10) Land scans of pastures. B. Where possible, Visual Analysis for fly larvae, mites, dung beetles as listed in species list above, plus any other insect, bug, worm, etc. (if found present). Microscopic Analysis on larvae, eggs, or smaller species.
Objective 3	Determine decreased / increased NWS attraction to aged blood / meat samples from Cattle fed phytochemical modified Ration as compared to control group. Determine increase / decrease in VOC's, Putrescine, and Cadaverine. A. Apply a "Paper-based biosensor that can rapidly detect putrescine levels in rotten meat." (A.S Selim et al., ACS Appl Bio Mater, 21, 5487 (2022). DOI: 10.1021/acsabm.2c00824) B. "Apply Rapid method for detection of muramic acid and cadaverine as indicators of microbial load on fresh meats" (https://dr.lib.iastate.edu/entities/publication/e80ea57b-db57-4812-b190-073f1887c6d1) C. Detailed Testing Standards Itemized with Cost of Analysis per sample and frequency in Financial Template. Over 80-lines of Specific Testing with Standards are offered. D. In Vitro, In Situ, and Functional Ranching quantitative and qualitative methods as validated by SME's and Best Beef Herd Practices. Where available specific methods are offered on Financial Template. E-1. From Meat, Hide, & Body Fluid Samples taken in slaughtered steers (1-each from Deer Run and Walkabout, respectively at 6-months and 12-months), aging of beef for up to 21-days or maybe longer to determine if the Female NWS will be attracted to lay her eggs. Compare to purchased meat samples. E-2: Repeat for NWS eggs placed into meat sample to determine if eggs mature in larvae. E-3: Repeat for NWS immature larvae placed into meat sample to determine maturation. E-4: Place NWS larvae and/or allow to naturally drop from meat samples into manure taken from Deer Run and Walkabout Ranchers, respectively.
Objective 4	Track overall Herd Health and Performance as mitigation against Fly Populations and NWS. Apply pragmatic tools used by real-time ranching operations like Deer Run Ranch and Walkabout Ranch. A. Herd Body Condition Scoring B. BUN C. MUN D. Disease Screening E. Healthy Herd Practices Evaluation.
Objective 5	Track shift in Manure Scoring, Pasture Odors, etc. indicative of sustainable mitigation of the Fly Populations and NWS through improved Herd Performance.

	A. Manure Analysis on fresh manure pats, and repeat every 45-day until project completion. Standards established by Cumberland Valley Analytical Services (CVAS). B. Forage Analysis on Day 1 repeated every 45-days until project completion. Standards established by Cumberland Valley Analytical Services (CVAS).
Overall Project	Where possible it is the intention of this project to create practical, real-world, and real-time analytical methods to be employed by ranching operations.

How Project Deliverables and Outcomes Will Be Shared

1. Ranchers will attend local, regional, and national meetings, forums, and conferences to present findings and will allow scheduled visitations to their ranching operations, 2. After Peer Review, University partners will publish findings, (3) Extension Services will provide information to disseminate, 4. IFUS will add to website

Potential Problems and Anticipated Solutions:

1. Potential Problem: Budget affected by inflation/other unforeseen forces. Mitigation: TIGHT budget controls.
2. Potential Problem: The Natural Phytochemical Enhanced Bovine Ration works on General Fly Population, but NOT the NWS. Mitigation 1: Use science to modify Ration to discover beneficial phytochemical that repels female NWS. Mitigation 2: Although not part of the proposal, emerging science is suggesting that where the Female NWS is attracted to indole-like compounds, VOC's, and like, the Male NWS seems to be attracted to flavonoid and flavonoid-like compounds. These initial studies support a hypothesis that when the Male NWS finds a flavonoid producing plant, it draws its nutritional requirements from it with evidence that select phytochemicals reduce its mating response. Beta- Caryophyllene may be one such phytochemical due to its analgesic capabilities and more.

Best Practices, Innovations, or Unusual Features

1. The Data Sets collected /generated will be used to create "6-Sigma Scatter Plots"; e.g. (a) Forage Analysis Plus, (b) Manure Analysis Plus, (c) Manure Scoring, (d) Herd Scoring, thus overlayed to (e) Fly Characterization and Population. Furthermore, the "Hub and Spoke Model" was applied as a basis for Project Design.
2. The application of a (a) biomass material containing the second most available biomaterial on the planet (recalcitrant lignin) and readily available in the U.S., (b) formulated with Chios Mastic Gum, Carob, and Ionic Minerals, and (c) processed to allow WRF and the natural microbial biome to serve as an in vitro pretreatment of the recalcitrant lignin.
3. (a) Eco-friendly (use of biomass waste product, possible reduction on intrinsic methane and other Greenhouse Gases, reduced water requirements and possible production of Carbon-Credits), (b) Cost-Effective (reduces beef ration costs from as much as $3.41/head/day to as low as $0.41/head/day, reduction in fly control, antibiotics, increased revenues from herd quality, and more as outlined specifically above in Economic Analysis) , and (c) Sustainable with assets for the product production typically in HUB-Z1 locations (e.g., IFUS Napoleonville Plant).

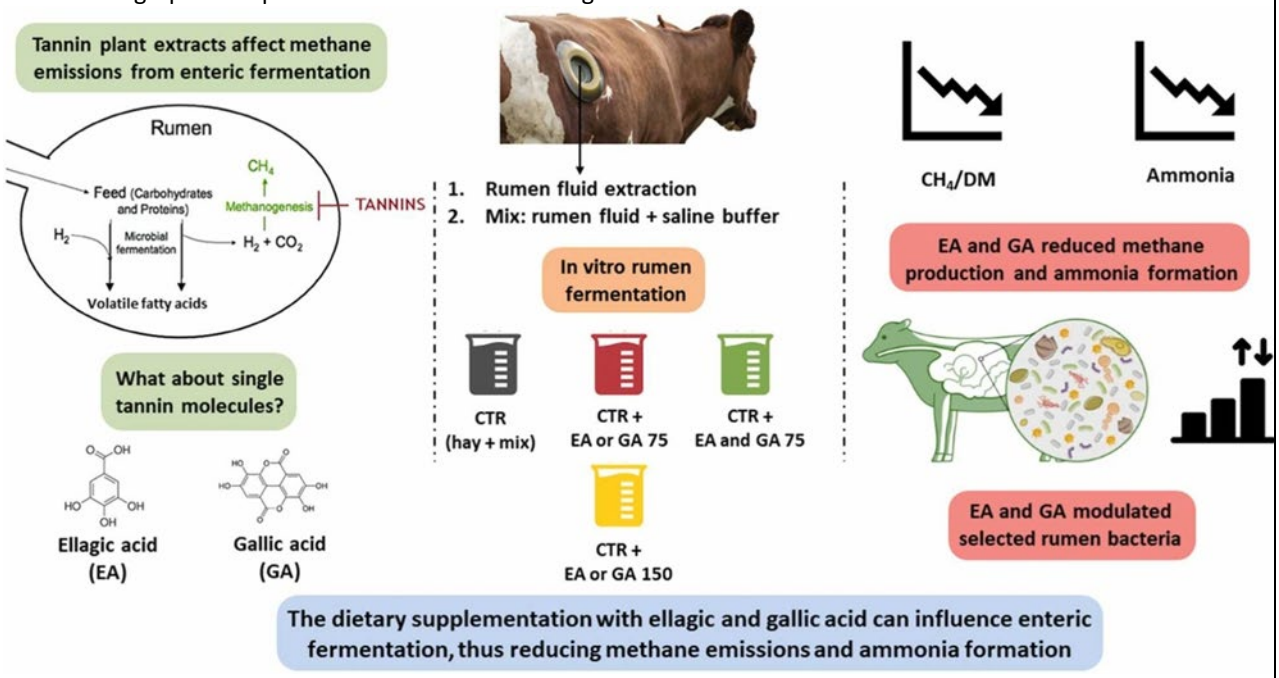
Other Information

1. In the last 5-years, scientific studies are revealing greater information regarding phytochemicals. Furthermore, the impact of White Rot Fungi (WRF) and other parts of the natural microbial biome found in biomass materials like Sugarcane Bagasse are rapidly evolving as alternatives to creating eco-friendly, cost-effective, and sustainable solutions for the management of beef and dairy cattle across the globe. The degradation and subsequent depolymerization of lignin by WRF (and other parts of the microbial biome) are offering new thinking into Bovine Ration Management. This includes the mitigation of predatory insects, bugs, and other pests (to include the NWS).
2. Phytochemicals like Gallic Acid are produced in lignin degradation and are contained in ingredients like Chios Mastic Gum and Carob. These are said to have an impact on rumen digestion. (Michele Manoni, et.al. in Animal Feed Science and Technology, Volume 305, November 2023, 115791, demonstrate the “Effect of ellagic and gallic acid on the mitigation of methane production and ammonia formation in an in vitro model of short-term rumen fermentation, Animal Feed Science and Technology, Volume 305, November 2023, 115791.” The study finds that "(1) Ellagic and gallic acid were assessed in an in vitro model of rumen fermentation, (2) Ellagic and gallic acid decreased methane emissions and ammonia formation. (3) Ellagic and gallic acid modulated the rumen microbial community."
3. One could plausibly extrapolate that Ellagic Acid (EA) produced from microbial activity in Sugarcane Bagasse works synergistically with Gallic Acid (GA). The EA enhances bovine digestion and subsequent absorption, while the GA

suppresses methane, especially if the in vitro degradation and depolymerization of lignin continues in vivo in the Upper GI of the bovine (where the lignin degradation allows free H+ to be converted into water rather than CH4). This would explain why ranchers claim reduced hydration requirements for their respective herds.

3a. Furthermore, “Lignin enhances the degradation of 17β-estradiol (E2) in bovine milk production. E2 has been shown to decrease milk production in dairy cows during gestation.” (“The role of lignin in 17β-estradiol biodegradation: insights from cellular characteristics and lipidomics,” Hanyu Pan, et.al., Microb Cell Fact 23, 347 (2024)). This offers explanation as to why ranchers are reporting "huge milk bags" on their lactating heifers.

3a. We find graphical representation of this in the diagram below:



4. One can plausibly extrapolate that if the evolving science on phytochemicals is correct, then a modified ration mixture high in natural phytochemicals could mitigate and/or ameliorate the NWS from beef and dairy herds. As time is seemingly of the essence, this proposed study intends to conduct pragmatic science-based trials and analysis to mitigate general fly populations and NWS by application of a Natural Phytochemical Enhanced Bovine Ration (NPEBR) to create a Defensive-Shield (of-sorts) around beef herds. The overarching perspective…integrated Herd Health and Performance.

5.. We find further evidence in support of this intention. Phytochemical like those found in Humic Substances (HS) are noted to be contained in Chios Mastic Gum and Carob, and produced by WRF depolymerization of Sugarcane Bagasse. Commercial application exists: “Effects of a dietary complex of humic and fulvic acids (FeedMAX 15™) on the health and production of feedlot cattle destined for the Australian domestic market. Conclusions: Feeding the humic and fulvic acid complex, FeedMAX 15™, at 0.055 g per kg body weight per day, can increase growth rate and feed conversion efficiency in feedlot cattle.” P M V Cusack, Aust Vet J., 2008 Jan-Feb;86(1-2):46-9. Hence, providing insight into the claims by beef ranchers of the increase in ADWG.

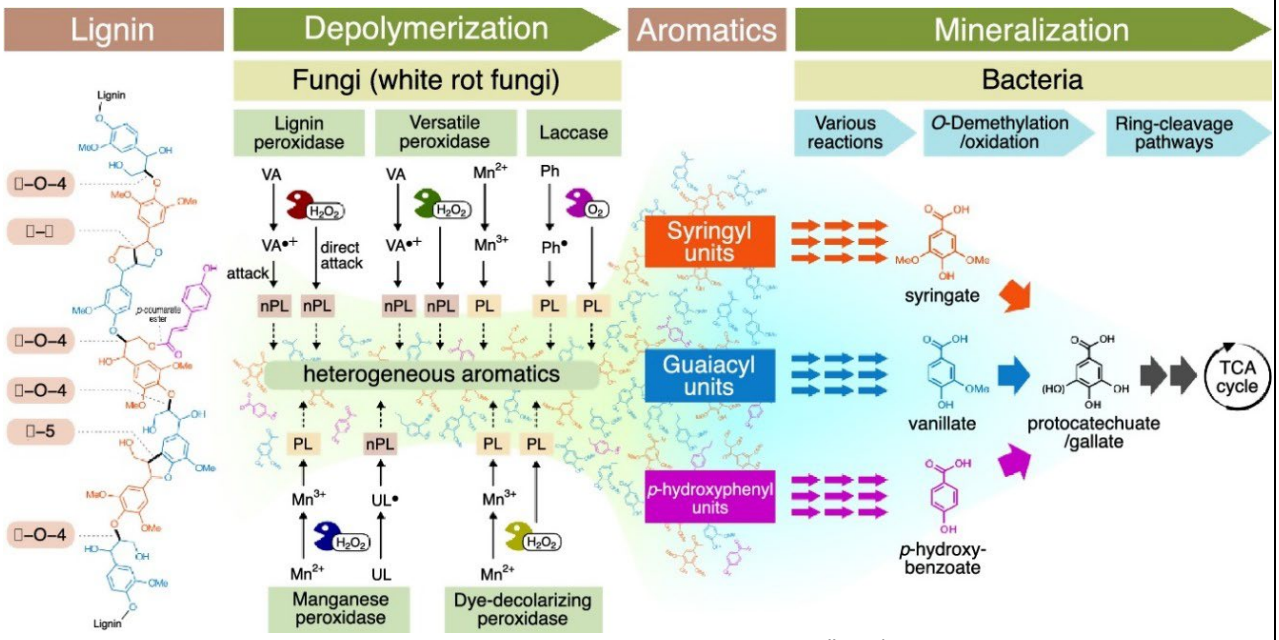
6. Yan, Q.; et. al., provide additional evidence as to the efficacy of a NPEBR: "Enhancing Agricultural Sustainability by Improving the Efficiency of Lignocellulosic Biomass Utilization in the Ruminant Diet via Solid-State Fermentation with White-Rot Fungi: A Review" (Microorganisms 2025, 13, 1708.). This addresses the concern over Crude Protein in the ration mix.

6a. "Studies have shown that treating SCB with specific white rot fungi, such as C. indica, can increase crude protein content by up to 104.1% and improve digestibility by 38.8%." (N. Khan, et.al.. Biotechnological Processing of Sugarcane Bagasse through Solid-State Fermentation with White Rot Fungi into Nutritionally Rich and Digestible Ruminant Feed. Fermentation 2024, 10, 181.)

6b. This is further supported by “The fungus Pleurotus ostreatus NRRL-2366 degraded 56.7% and 45.9% of untreated and chemically pretreated (delignified) sugarcane bagasse, respectively, during 14-day incubation in a submerged fermentation process. The biodegradation percentages of cellulose, hemicellulose and lignin were 33.0%, 72.5% and 14.5%, respectively. An increment of 22.6% of crude protein content in the residual fermented material was

observed. Chemical composition of the end-product and its amino acids profile were reported.") "Bioconversion of sugarcane bagasse into a protein-rich product by white rot fungus", Samir A. El-Sayed, et.al., Resources, Conservation and Recycling, Volume 12, Issues 3–4, November 1994, Pages 195-200). Hence, an explanation of the significant decrease in SB vs. SGP+™ vs SGP+™/Ration vs. Manure (beginning at 28% lignin in untreated SB to 6-7% lignin in Manure tested by CVAS).

6c. N. Kamimura, et.al., reveal: "Advances in microbial lignin degradation and its applications," Current Opinion in Biotechnology, Volume 56, 2019, Pages 179-186 (See Diagram Below). Note the significance of the overall microbial biome, sustained and supported by Humic Substances, especially in the presence of a naturally balanced ionic mineral source. The progression from lignin (depolymerized by WRF), followed by interaction with the bacterial portion of the microbiome, then leads to protocatechuate (or Dihydroxybenzoic acids) production, and the esterified form of gallic acid known as gallate.



6d. Coincidentally, science is suggesting to us that Dihydroxybenzoic acids "don't actually repel insects, but rather block the receptors that mosquitoes, gnats, punkies, no-see-ums and other insects use to detect appropriate hosts for them to bite. Blocking those receptors stops the insects from biting, so a more accurate term might be 'bite-preventing substances.' By the way, they can also repel some insect relatives such as ticks." (Resource000963_Rep1073.pdf). Now overlay, "Screwworm females are attracted to wounds that may be as small as those caused by the feeding of the invasive cattle tick Rhipicephalus (Boophilus) microplus" (World Organisation for Animal Health, 2013), which has periodic outbreaks in Mexico and south Texas (Pérez de León et al., 2012). This may be the basis of a "Defensive Shield" of sorts.

5. Additionally, "Research shows that tannins can help control internal parasites in livestock. By affecting the gut environment, they create conditions less favorable for parasite survival and reproduction. This effect can lead to healthier animals with improved growth performance." "Tannin in Ruminant Nutrition: Review", M. Besharati, et.al., Molecules. 2022 Nov 27;27(23):8273, and "The effects of tannin-rich plants on parasitic nematodes in ruminants," Hervé Hoste, et.al., "The effects of tannin-rich plants on parasitic nematodes in ruminants," Trends Parasitol. 2006 Jun;22(6):253-61. Hence, more evidence to support and establish overall Herd Health and Performance.

6. The IFUS Website offers White Papers that further explore the impact of SGP+™/NPEBR™ on metabolic pathways, like the TCA illustrated above. This includes emerging research on Rumen Mitochondrial activity in relationship to phytochemicals contained in ingredients like Chios Mastic Gum, Carob, Depolymerized Lignin by WRF, and minerals.

7. Phytochemical impacts on metabolic pathways are explored in studies like: "From By-Products to Promising Bifunctional Food Ingredients: Physicochemical Characterization and Antioxidant and Emulsifying Improvement Evaluation Based on the Synergy of Phenolic Acids, Flavonoids and Tannins with Bovine Liver Hydrolysates. Foods 2025, 14, 2225. https://doi.org/10.3390/foods14132225" offers "Conclusions: The results showed that the interaction system of EGCG, GA, TA and BLHs provided an effective intervention strategy to enhance the antioxidant

and emulsifying properties of bovine liver hydrolysate." Hence, one could plausibly consider the impact that the liver has on indole-like NWS attractant leaching from the flesh into the hide vs. flavonoid-like phytochemicals that improve Herd Health, Disease Resistance, Enhanced Healing, Hide Finish, and natural phyto-chemical defense against the NWS.

8. Mastic and Carob both contain Gallic Acid. Gallic Acid is part of the family of Gallotannins. “Gallotannins are scarcely found in nature and are the most basic hydrolysable tannins, consisting of gallic acid derivatives which contain six or more galloyl groups" Hence, a possible novel solution exists from natural mitigation of NWS from biting cows.

9a. “Gallotannins, a class of tannins, commonly occur in many plant species and cause insect toxicity. They are potent inhibitors and disruptors of bacteria2. While they don't fully repel bugs, they can partially repel insects.” “Recognition of Gallotannins and the Physiological Activities: From Chemical View,” Hua-Feng He, Front Nutr. 2022 Jun 1.

9b. “Gallotannins, characterized with the glycosidic core and galloyl unit, are seemed as vital component of hydrolyzable tannins. More than that, activities involving in antioxidant, anti-inflammatory, enzyme inhibitions, protein binding, and so on, as well as applications in the field of food industry, biopharmaceutical science, agricultural production, etc., were combed.” Hence, more evidence of creating a healthier herd.

10. Microbes found in Sugarcane Bagasse can convert lignin into Gallotannins. “In the early 1960s, enzyme studies increasingly began to replace the common ‘feeding’ experiments in which labeled tracers were applied to living plants or plant parts for elucidating metabolic pathways. This advanced technique allowed to gain much deeper insights into individual details of metabolic sequences, and particularly on the previously inaccessible role of activated ‘energy-rich’ intermediates. Based on the author’s own experience for the past 40+ years in this field, principal findings and trends elucidating the pathways to lignin and lignin precursors, acyl amides and hydrolyzable tannins (gallotannins, ellagitannins) by enzyme studies are reported. “From lignins to tannins: Forty years of enzyme studies on the biosynthesis of phenolic compounds,” Georg G. Gross, Phytochemistry, Volume 69, Issue 18, December 2008, Pages 3018-3031. Hence, all ingredients in SGP+™ seem to possess similar phytochemicals working in concert to produce Healthier Herds and phytochemical insect resistant capabilities to include flies.

11. More evidence is found in "Effects of Plant-Based Antioxidants in Animal Diets and Meat Products: A Review, C.D. Petcu, et.al., "Effects of Plant-Based Antioxidants in Animal Diets and Meat Products: A Review." Foods. 2023 Mar 21;12(6):1334, as well as "M. Oleszek, et.al., Phytochemicals Derived from Agricultural Residues and Their Valuable Properties and Applications. Molecules 2023, 28, 342.

12. And, a healthy cow's hide requires the correct tannins. Coincidence or Mother Nature at her best?

13. Lastly, as wound prevention and rapid wound healing reduces VOC’s and other odorants produced from wounds, “Beta-caryophyllene enhances wound healing through multiple routes,” S. Koyama, et.al., "Beta-caryophyllene enhances wound healing through multiple routes. PLoS One. 2019 Dec 16;14(12):e0216104.

14. Through a Multi-Tiered, Interrelated Strategy of (1) Improved Herd Health, (2) Increased Healing if Injury Occurs, (3) Beneficial Phytochemicals that (a) secrete odors as repellants, (b) exhibit anti-larvicidal properties, (c) improve hide, meat, and milk quality, (4) decrease Levels of VOC's or other NWS odor attractants, (5) utilize a biomass material, so as to formulate a Natural Phytochemical Enhanced Bovine Ration, could create a Defensive Shield around beef herds (so as to the Prevent and Mitigate impacts from the NWS).

15. Literally thousands of pages of scientific study have been reviewed and summarized in a series of ever-evolving White Papers available for review and scrutiny. Any individual study suggests coincidence. However, when countless studies overlay into plausible science, then further exploration is warranted.

16. This journey started 12-years ago with analysis performed by the L.S.U. Southeast Research Station Forage Quality Lab. A marked and surprising I.V.T.D. improvement of SGP+™ (as compared to Sugarcane Bagasse (47.5% vs 32.0%, respectively)) was noted. Where by this analysis alone SGP+ should NOT produce the Herd Performance claimed by ranchers and dairymen, per Dr. Mike McCormick, it does beg the question as to what caused this significant improvement in I.V.T.D. Hence, this grant proposal contends that based on Herd Performance to date, SGP+™ applied as part of a Natural Phytochemical Enhanced Bovine Ration mitigates general fly populations in an eco-friendly, cost-effective, and sustainable manner. It could well provide a remedy for the NWS, while generating a break-through in (a) Herd Performance, (b) Greenhouse Gas Reduction, (c) and a breakthrough in Bovine Ration Management

V. BUDGET JUSTIFICATION / RESOURCES REQUIRED

Personnel Funded by the Project

Personnel	Role and Justification for Each Position / Person

Objective 1: Validate Mitigation and Amelioration of General Fly Populations reducing costs and overall	
	No grant monies will be used to compensate any member of the IFUS team. All monies will be used to support OSU (or equivalent university efforts where appropriate), and secure Analytical Services by outside 3rd Parties like Cumberland Valley Analytical Services and SME's. Entomologist = 564-hrs.
OSU SME's Proj. Coord.	OSU: Photographic and Video evidence as well as Trip Reports and Analysis will be received, reviewed, and scrutinized by OSU Team Members. SME's: These individuals will (1) be present at both Deer Run Ranch and Walkabout Ranch every 45 days for 1 year, (2) receive weekly updates from the active ranches, (3) be provided all analysis performed by any team member, (4) have access to all relevant project data Proj. Coord.: Will validate overall project progression of each Objective and course correct on deviations. (Total Team Hours approximately = 950-hrs.
Entomologis t	8-Visits to 2-ranches to survey, analyze, collect samples, report, coordinate, and offer guidance with overall project. Focus Fly Population and Characterization. 564 hrs
Objective 2: Determine Soil Amended Quality with Ration Modified Manure Pats to create larvicidal activity against Fly Populations, soil that may prevent NWS larval development, reduce need for acid-based synthetic fertilizers from recycling of Humic Substances, and healthier, more plentiful grass with cost-savings. Per Deer Run Ranch, "… we stretch our grass a bit farther."	
Soil Scientist	Physical visits, Soil collection, Soil Survey, Analysis Results Interpretation, Reporting (120-hrs)
Objective 3: Determine decreased / increased NWS attraction to aged blood / meat samples from Cattle fed phytochemical modified Ration as compared to control group. Determine increase / decrease in VOC's, Putrescine, and Cadaverine.	
DVM	Carcass Autopsy, Herd Health Panels, 8-visits to 2-ranches for herd observation, Data Collection, Data Analysis, Reporting, Coordination with Team, Trial Recommendations (600-hrs)
Animal Scientist	Carcass Analysis Supervision, 8-visits to 2-ranches for herd observation, Data Collection, Data Analysis, Reporting, Coordination with Team, Trial Recommendations. Hours = 100 hrs..
Objective 4: Track overall Herd Health and Performance as mitigation against Fly Populations and NWS. Apply pragmatic tools used by real-time ranching operations like Deer Run Ranch and Walkabout Ranch. A. Herd Body Condition Scoring B. BUN C. MUN D. Disease Screening E. Healthy Herd Practices Evaluation.	
Animal Scientist	8-visits to 2-ranches, herd observation and evaluation, sample collection, data analysis, reporting, coordination with team, Trial recommendations Hours = 240-hrs (average over multiple objectives)
Objective 5: Track shift in Manure Scoring, Pasture Odors, etc. indicative of sustainable mitigation of the Fly Populations and NWS through improved Herd Performance.	
Animal Scientist	8-visits to 2-ranches, herd observation and evaluation, sample collection, data analysis, reporting, coordination with team, Trial recommendations Hours = 140-hrs

Fringe Benefits

Personnel	Rate	Fringe Benefit Description
Objective 1: All other personnel draw no salaries. SME's are contracted. Hence, no Fringe Benefits are applicable.		
Objective 2: All other personnel draw no salaries. SME's are contracted. Hence, no Fringe Benefits are applicable.		
Objective 3: All other personnel draw no salaries. SME's are contracted. Hence, no Fringe Benefits are applicable.		
Objective 4: All other personnel draw no salaries. SME's are contracted. Hence, no Fringe Benefits are applicable.		
Objective 5: All other personnel draw no salaries. SME's are contracted. Hence, no Fringe Benefits are applicable.		

Travel:

	Traveler Name or Position Name	Trip Purpose, Justification, and Objectives Where Travel is Needed (NOTE: Each Line Represents 1-	Starting Location & Destination	Means of Travel	# nights lodging	Total mileage (if local travel)

		Trip / 45-days for each team member for a total of 8- trips for the testing period (12 months))				
Trip #1a	Marc Walther	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip
Trip #1b	Marc Walther	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip
Trip #2a	Assistant	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip
Trip #2b	Assistant	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip
Trip #3a	Animal Scientist	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip
Trip #3b	Animal Scientist	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip
Trip #4a	DVM	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip
Trip #4b	DVM	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip
Trip #5a	Entomologist	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip
Trip #5b	Entomologist	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip
Trip #6a	Soil Scientist	Verify Work / Collect Data / Collect Samples/ Discuss Project Progress at Deer Run Ranch	Napoleonville, LA to Jefferson, TX	Car	1	710 miles Round Trip

Trip #6b	Soil Scientist	Verify Work / Collect Data / Collect Samples Discuss Project Progress at WalkAboutRanch	Jefferson, TX to Anthony, KS	Car	1	532 miles Round Trip

Equipment

Type of Equipment to be Purchased	Purpose, Justification, and Objectives Where Equipment Will Be Used	Quantity
Photographic / Video/Computer	Deer Run Ranch and Walkabout Ranch will be technologically enabled for remoted monitoring between physical visits. This technological enablement will provide inputs into Objective 1/2/4/5. The specifications, details, and costs of the equipment are provided on the Financial Template.	2

Ranchers will be allowed to maintain Herd Monitoring with the agreement of continued data sharing with OSU (or equivalent university), SME's, and the U.S.D.A. (if desired). Continued study on Herd Performance in relationship to Natural Phytochemical Enhanced Bovine Ration will be ongoing to investigate other benefits and/or limitations, including monitoring of the NWS.

Supplies:

Type of Supplies to be Purchased	Purpose, Justification, and Objectives Where Supplies Will Be Used (See Financial Template for Specific Quantities)	Quantity
Sampling Storage and Transport Containers	Itemized Detail Provides Purpose/Justification/Objective/Cost	Lines50-51
NWS Testing Lab Supplies	Testing on Ration modified hide, flesh, and carcass fluids	Lines 50-51

Contracts/Subawards:

Name of Contractor/ Subaward Recipient	Purpose, Justification, and Objective(s) Where the Contract or Subaward Will Contribute	Foreign or Domestic Entity?
OSU or Equivalent Academic Institution	Data Collection, Coordination, Scrutiny, Reporting. Does the data reconcile into a plausible "Defensive Shield" of-sorts to protect beef herds from the NWS. Competitive Bid	Domestic
Cumberland Valley Analytical Services	Ration and Manure Analysis Data (Objective 1 & 2) Sole Source	Domestic
DVM	Herd Scoring, Carcass Autopsy, Health Assessments, Blood and Urine Draws, Data Analysis (Objective 3) Competitive Bid	Domestic
Animal Scientist	Herd Scoring, Ration Management Sample Collection, Manure Sampling Collection, Data Analysis (Objectives 4 & 5) Competitive Bid	Domestic
Entomologist	Fly Management, NWS Study on Meat Samples (Objective 1) Competitive Bid	Domestic
Soil Analysis Services	Sample Collection and Data Analysis (Objective 2) Competitive Bid	Domestic

Other Costs

Type of Other Cost	Purpose, Justification, and Objective(s) Where Other Costs Apply
Analytical Testing	Quantitative Data/Certified Lab/Objective 5

Contracted Services / SME's (Entomologist, Soil Scientist, DVM, Animal Scientist	Expertise/Respective SME/Certified/Entomologist-Objective 1, Soil Scientist-Objective 2, DVM-Objective 3, Animals Scientist-Objective 3,4&5.
OSU (or Equivalent Contracted University	Data Assimilation, Evaluation/Peer Review, Reporting, Communication/ Beef Science Expertise/ Objectives 1/2/3/4/5
Computer Support	Video Data Capture/Fly Assessment and Herd Performance Monitoring on Active Ranches/ Objectives 1/2/4/5

Cost Sharing

Objective #	Contribution	Purpose, Justification for the Contribution
1-5	IFUS Personnel	Project Oversight, Business Perspective

In-Kind Contributions to the Project

Objective #	Contributor Name	Type of Contribution	Contribution Description	Quantity
1-5	Walk-About Ranch	Use of Herd	Real Time Active Testing	250 Hd
1-5	Deer Run Ranch	Use of Herd	Real Time Active Testing	175 Hd

VI. SUPPLEMENTAL INFORMATION

Qualifications and Relevant Experience of the Principal Investigator and Lead Technical Experts

Name and Title	Marc Walther, CEO
Organization	Impact Fusion International, Inc. in cooperation with owners of Deer Run Ranch (Jefferson, TX) and (Walkabout Ranch, Anthony, KS)
Role in this Project	Principal Investigator. (IFUS would be willing to relinquish the Principal Investigator Role and Financial Control to a qualified and passionate Principal.)
Qualifications and Relevant Experience	For over 12 years now, Marc Walther has invested countless hours and raised money to support research and product production in support of success stories he has heard and seen from once struggling ranchers. He has made numerous trips to both Deer Run Ranch and Walkabout Ranch, and has recently traveled to India where in a 15-day trial on 2 Non-lactating Holstein-Friesian (HF) Crossbred Heifers (ages 4 and 3.5 years) at 940-lbs and 748-lbs, respectively, a Natural Phytochemical Enhanced Bovine Ration Trial, supervised by Dairy Scientist and DVM's from SUMUL Dairy, reported that where Milk fat percentage were the same, SNF (Solid-non-fat) percent increased by a range of 0.6-0.8%. He has spoken to and read studies from countless scientists across the globe. He has gathered the information from them and used several to compile information in "Knowledge Base" on his company's website (www.impactfusionbrands.com/). His passion and experience qualify him as a businessman/entrepreneur to lead this initiative, as he believes that he has products, that if applied as technologies, could allow ranchers and dairymen both in the U.S. and abroad to replicate the successes of Deer Run Ranch and Walkabout Ranch. His skill set is finding talent and expertise so that it can be harnessed to created results. Hence, as this proposal is vetted, he is vetting SME's to participate and commit to its success.

Information and Data Management

- All information remitted to OSU or equivalent university.
- Each SME will prepare Trip Reports: Observations, Data Collection, Photographic/Video Evidence, Data Analysis/Conclusions, Recommendations, Errors, Course Corrections, and/or any other Relevant Information.
- Lab Analysis remitted to OSU will be copied to IFUS, ranching operations, and SME's.
- (1) As Trips to Deer Run Ranch and Walkabout Ranch will occur every 45 days, Trip Reports will be due within 15-days of the Trip, unless Data Analysis requires more time. (2) The reports will be complied and shared in a common data base where ALL SME's, Ranching Operations, and other pertinent personnel can access.
- (1) All data remitted to OSU (or equivalent academic institution) will be compiled and evaluated, then reviewed for commentary, and feedback. (2) OSU will be the secure "keeper" and "watch-dog" of ALL project information (to include budget information remitted by IFUS).

Knowledge and Technology Transfer

Should OSU agree, Oklahoma State (or equivalent academic institution) will determine if findings warrant publication in juried journals, share at Beef Cattle / Dairy Cattle Forums or Conferences, or other academic or industry function. Furthermore, per the OSU Extension Service: "From livestock arenas to correctional gardens, Extension educators across Oklahoma have worked to empower youth, equip adults with practical skills and build stronger communities. County educators and specialists serve communities and make a difference in the lives of Oklahomans." Furthermore, as a nationally recognized in "cow-country", OSU is poised to share knowledge, technology, and results with both the U.S. and international beef operations. Lastly, OSU's proximity to the test ranches involved with this project will make visits from OSU/SME's as well as visitors from other locations. Both test ranches presently welcome visitors into their operations. Other than protecting its Proprietary Formulations and Processes, IFUS wants to make a difference through sustained scientific fact. It believes its stakeholders benefit by doing so.

Existing Patents, Code, Data Rights

IFUS Formulations applied to the Natural Phytochemical Enhanced Bovine Ration proprietary, trademarked and/or patent protected. However, the overall ration management strategy is open to modification and open to public application (less the IFUS Formulations). Data, with the exception of IFUS Formulations, will be public knowledge (less restricted by granting authority).

DETAILED FINANCIAL PLAN TEMPLATE

APHIS COOPERATIVE AGREEMENT DETAILED FINANCIAL PLAN

This Financial Plan must match the SF-424A, Section B – Budget Categories. Funding requested under the budget categories must be described in detail in the Work Plan. Please refer to 2 CFR

Project Title	NWS Mitgation Through Natural Phytochemical Enhanced Bovine Ration
Recipient Name	Impact Fusion International, Inc in Cooperation with Deer Run Ranch (Jefferson, TX) and Walkabout Ranch (Anthony, KS)

		Flies	Soil & Manure	NWS Attraction	Herd Health	Analytics	
Cost Category	**Item Description and Quantity**	**Work Plan Objective 1 Total Costs**	**Work Plan Objective 2 Total Costs**	**Work Plan Objective 3 Total Costs**	**Work Plan Objective 4 Total Costs**	**Work Plan Objective 5 Total Costs**	**Total Budget**
Personnel	Marc Walther	0	0	0	0	0	$0
	Rhonda Windsor	0	0	0	0	0	$0
	Personnel Subtotal						**$0**
Fringe Benefits	Name % Fringe; $ insurance per month	0	0	0	0	0	$0
	Name % Fringe; $ insurance per month	0	0	0	0	0	$0
	Fringe Subtotal						**$0**
Equipment	SYSTEM DESIGN This system uses 4 twenty-foot poles positioned around the feeding area. Each pole carries two cameras: one long-range PTZ (pan-tilt-zoom) camera for wide coverage and one fixed close-up camera aimed directly at the feed bunk. This gives you full situational awareness of the entire herd plus detailed behavioral footage suitable for the AI vision analysis outlined in the research proposal. All cameras are commercial IP-grade with PoE (Power over Ethernet), meaning a single Cat6 cable runs power and data to each camera — no separate power wiring at each pole. The NVR stores 30+ days of continuous footage locally and streams live to any authorized device, anywhere with internet access.						$0
	Hikvision DS-2DE4A425IWG-E 4MP PTZ IP Camera — long range, 25x optical zoom, IR night vision 100m, IP67 weatherproof (wide area coverage) 4 Units x 2 Ranches @ $650/unit	1300	1,300		1,300	1,300	$5,200
	Hikvision DS-2CD2T47G2-L 4MP ColorVu Fixed Turret Camera — full color night vision, close-up feed bunk detail (behavioral observation) 4-Units x 2-Ranches @ $280	560	560		560	560	$2,240
	Heavy-duty galvanized pole mount brackets, adjustable tilt, per camera 8-Poles x 2-Ranches @ $45/Pole	180	180		180	180	$720
	NEMA 4X weatherproof junction boxes with cable entry glands, per camera 8-Boxes x 2-Ranches x $35/eaach	140	140		140	140	$560
	Galvanized steel camera poles, 20ft, 4-inch diameter, with base flanges (set of 2 cameras per pole) 4-Camera Poles x 2-Ranches @ $420/Camera Pole	840	840		840	840	$3,360
	Anchor bolt sets and base plate hardware per pole 4-Bolts x 2- Ranches @ $55 / Bolt	110	110		110	110	$440
	Concrete, 60lb bags — estimated 8 bags per pole footing for stable installation 32-Bages x 2-Ranches @ $ 8.50 / Bag	136	136		136	136	$544
	Hikvision DS-7616NI-I2/16P 16-channel PoE NVR with 8TB HDD — local storage approx. 30 days continuous 1-Unit x 2-Ranches @ 1200/unit	600	600		600	600	$2,400
	Ubiquiti UniFi PoE Switch 16-port — powers all cameras over ethernet, eliminates separate power supplies 1-Unit x 2-Ranches @ $450/unit	225	225		225	225	$900
	Ubiquiti UniFi Cloud Key Gen2 Plus — enables 24/7 remote live stream and playback via browser and mobile app with multi-user access 1-Unit x 2-Ranches @ $180/unit	90	90		90	90	$360
	Cat6 shielded outdoor-rated ethernet cable, 500ft spool 2-Units x 2-Ranches @ $145 / Unit	145	145		145	145	$580
	PVC conduit, Schedule 40, 1-inch diameter for underground/surface cable runs to poles, per foot 200-Units x 2-Ranches @ $1.80 / Unit	180	180		180	180	$720
	Conduit fittings, connectors, straps, end caps — lot 1-Unit x 2-Ranches @ $120/unit	60	60		60	60	$240
	Weatherproof lockable outdoor cabinet for NVR, switch, and cloud key 1-Unit x 2-Ranches @ $280 / Unit	140	140		140	140	$560
	Peplink MAX BR1 Mini cellular 4G LTE backup router — maintains remote access if primary wireless fails 1-Unit x 2-Ranches @ $320 /unit	160	160		160	160	$640
	60A outdoor-rated sub-panel, dedicated circuit for camera and network system 1-Unit x 2-Ranches @ $220 / unit	110	110		110	110	$440
	Breakers, wire, conduit for circuits from sub-panel to equipment cabinet — estimated materials 1-Unit x 2-Ranches @ @ $350/unit	175	175		175	175	$700
	APC 1500VA UPS uninterruptible power supply — keeps NVR and network online during brief power interruptions 1-Unit x 2-Ranches @ $195/unit	97.5	98		98	98	$390
	Outdoor-rated surge protectors with lightning protection, one per pole 4-Units x 2-Ranches @ $65 /Unit	130	130		130	130	$520
	LED flood light 200W 5000K daylight, IP65 rated, pole-mount — covers approx. 80x80ft per fixture 6-Units x 2-Ranches @ $185 / Unit + Quarterly Main	1110	1,110		1,110	1,110	$4,440
	Adjustable pole-mount arms for flood lights 6-Units x 2-Ranches @ $39/Unit	117	117		117	117	$468
	Photocell dusk-to-dawn controllers — automatic on/off, one per fixture 6-Units x 2-Ranches @ $22 / Unit	66	66		66	66	$264
	Additional wire and conduit for lighting circuits — estimated materials 1-Unit x 2-Ranches x $285 / Unit	142.5	143		143	143	$570
	Panasonic Toughbook FZ-55 MK3, 14-inch FHD 1920x1080 Multi-Touch Display, Intel Core i7-13th Gen vPro up to 5.2GHz, Intel UHD Graphics, 32GB, 1TB SSD, 4G LTE, Wi-Fi 6E, Windows 11 Pro at 3933.25/unit x 2-ranches	1967	1,967		1,967	1,967	$7,868
	High-Performance Computer Software Installation and Licenses $1800/unit x 2-Ranches	900	900		900	900	$3,600
	Equipment Subtotal						**$38,724**

Cost Category	Item Description and Quantity	Work Plan Objective 1 Total Costs	Work Plan Objective 2 Total Costs	Work Plan Objective 3 Total Costs	Work Plan Objective 4 Total Costs	Work Plan Objective 5 Total Costs	Total Budget
Supplies	Manure Sampling Supplies & Packaging 5-samples x 8-visits x 2 ranches @ $25/unit					2,000	$2,000
	Forage Analysis Sample Packaging 5-samples x 8 visits x 2 ranches @ $25 / unit					2,000	$2,000
	Phytochemical Supplement Suppied by IFUS as Match-In Kind 40-2000lb bales/mo x 12 months x 2-rannches @$100/bale	24000	24,000		24,000	24,000	$72,000
	Soil Testing Sampling Supplies & Packaging 5-Samples x 8-visits x 2-ranches @$25/unit		2,000				$2,000
	NWS Testing Lab Supplies			13,450			$13,450
	Supplies Subtotal						**$91,450**
Other	Oklahoma State or Equivalent University Contracted: Weekly Reports from 2-Ranches + 8-reports from three SME's + CVAS Analysis + Soil Analysis Data Compelation / Analysis / Commentary / Reporting / Public Communication at 52 weeks from 2-Ranchers + 8-Testing Visits with 3-SME's reporting olus Lab Result Analysis at 52-weeks@20-hrs/week + 24-days on SME Visit Reporting @ 760 hrs total x PhD Animal Scientist, Admin, PhD Candidate = 80/hr (averaged loaded costs) x 760 hrs =	18,974	18,974	18,974	18,974	18,974	$94,870
	Video Installation and Tech Support for Commissioning 2-Techs x 20hr/tech @ $75/hr/tech loaded costs x 2 ranches	1,340	1,340		1,340	1,340	$4,020
	On-Going Video Tech Support 2-Techs x 3hrs/tech x 6-visits x 2- Ranches @ $75/hr/Tech loaded costs	675	675		675	675	$2,025
	Contractor Entomologist @ $100 / hr @ 10-hr/day x 8-visits x 6-days/visit + Lab Analysis of NWS to Rotting Meat Samples @ 21-days for 4hrs/day	48,000		8,400			$56,400
	Contractor DVM @ $125 / hr @ 10-hrs/day x 8-visits x 6-days/visit			60,000			$60,000
	Contractor Animal Scientist @ $100 / hr @ 10-hrs/day x 8-visits x 6-days/visit		16,000		16,000	16,000	$48,000
	Contractor Soil Scientist Sampling Design, Management, Analsysis of Lab Results, and Reporting		12,000				$12,000
	Cumberland Valley Analytical Services / Manure Analysis + S/H Costs. All Manure Samples will be composites taken from 2-ranches x 8-sampling + S&H ($45.00 U.S./composite/ranch						$0
	Manure Package + Total Carbon + C:N Ratio – $127.00 x 2 x 8) =					2,392	$2,392
	Manure Package + Minerals Only (High Concentration) – $88.50 x 2 x 8 =					1,416	$1,416
	Manure Package + Fermentation Analysis Plus – $48.75 x 2 x 8 =					780	$780
	Manure Package + Fatty Acid Profile (100m column) – $166.00 x 2 x 8 =					2,656	$2,656
	Manure Package + ADICP – $323.50 x 2 x 8 =					5,176	$5,176
	Manure Package + Calories (BTU) – $24.00 x 2 x 8 =					384	$384
	Manure Package + Crude Fiber – $11.50 x 2 x 8 =					184	$184
	Manure Package + Crude Protein – $56.00 x 2 x 8 =					896	$896
	Manure Package + Degradable Protein – $130.75 x 2 x 8 =					2,092	$2,092
	Manure Package + Fat (Ether Extract) – $221.75 x 2 x 8					3,548	$3,548
	Manure Package + Fecal Starch – $11.50 x 2 x 8 =					184	$184
	S&H ($65.00 x 2 x 8)					960	$960
	Cumberland Valley Analytical Services / Forage Analysis + S/H Costs						$0
	A. Includes the Standard Package and Lignin, Fat, ADFCP, NDFCP, Chloride, Sulfur, Starch, Sugar, NFC, TDN, NEl, NEm, and NEg. When combined with our Fermentation Analysis a Soluble Fiber is calculated. High-fat samples may incur additional fat-extraction charges for ADF, NDF and Lignin analyses. RFV Package 36.00 Includes Dry Matter/Moisture, Crude Protein, ADF, NDF, calculated RFV (on hays and haylages), and Adjusted Protein. NEl, NEm, NEg and TDN on forages only. High-fat samples may incur additional fat-extraction charges for ADF and NDF analyses. $159.50 / analysis x 5-samples/visit x 8 visits + $35/sampe S&H. = $6380 Sample Analsis + $1400 S&H = $7780 x 2 ranches =					15,560	$15,560
	B. Mineral Only (High Concentration) Package 57.50 High concentration materials (mineral ingredients, premixes, high mineral concentrates). $57.50/ analysis x 5 samples/visit x 8-visits + S&H covered in overall samples = $2300 x 2-ranches = $4600					4,600	$4,600
	C. TMR Diagnostic Package Includes CNCPS Package, Ammonia, Lactic Acid, Acetic Acid, Butyric Acid, 7-hour Starch Digestibility, 24-hour NDF Digestibility, peNDF (physically effective NDF - Mertens), SPS (starch processing score), and the Penn State Particle Size Evaluation. $375/sample x 1-Composite samples / visit x 8 visits x 2-Ranches =					6,000	$6,000
	D. Fermentation Analysis Plus Fermentation Includes Dry Matter/Moisture, Lactic Acid, Acetic Acid, Propionic Acid, Butyric Acid, Iso-butyric Acid, Valeric and Iso-Valeric, 1,2 - Propanediol, Total VFA, pH, Lactic Acid/VFA ratio, Crude Protein equivalent from Ammonia as a percentage of Dry Matter and Crude Protein. Includes Fermentation Analysis as well as a breakdown of Alcohols, Acetates, and Lactates. $63.50/sample x 5-Samples x 8-visits x 2-ranches					5,080	$5,080
	Mold Identification Mold/Yeast Count with Mold Identification. $69.50/sample x 5-samples x 8-visits x 2-ranches					5,560	$5,560
	Toxic Elements Panel Includes Arsenic, Lead, Chromium, and Mercury $86.00 /sample x 1-Composte Sample x 8-visits x 2-ranches					1,376	$1,376
	Trace Element Panel includes Cobalt, Copper, Iron, Manganese, Molybdenum, Selenium, and Zinc. $86.00 1-Composite sample x 8-visits x 2-ranches					1,376	$1,376

Cost Category	Item Description and Quantity	Work Plan Objective 1 Total Costs	Work Plan Objective 2 Total Costs	Work Plan Objective 3 Total Costs	Work Plan Objective 4 Total Costs	Work Plan Objective 5 Total Costs	Total Budget
Amino Acids/ Proximate	In Vitro Analysis: CVAS has the capacity to run most any sized in vitro project with all samples inoculated from a single run of comingled rumen fluid. Our in vitro facility has over 2000 incubator flask positions. All In Vitro Analysis will be performed on Composite Samples for 2-ranches and 8-samplings						$0
	A. Multistep In Vitro Protein Evaluation (MSPE): Based on work by Dr. Debbie Ross and Dr. Mike Van Amburgh. An In vitro evaluation of feed material is followed by treatment sequentially with acid and enzymes. Rumen availability as well as intestinal digestibility is provided. Needs to be run with Crude Protein. $167.75 x 8 Composite Samples x 2 ranches					1,342	$1,342
	B. MSPE, Freeze Dry: Needs to be run with Crude Protein. $211.50 x 8 x 2					3,376	$3,376
	C. ROSS UIP: Total tract protein digestibility and indigestibility. Needs to be run with Crude Protein. $104.00 x 8 x 2					1,664	$1,664
	D. NDF Digestibility In Vitro Per Time Point 6, 12, 24, 30, 48, 120 or 240 hrs (uNDF). Other time points may be available upon request. A request for a 72 hr or higher time point needs to be run with NDFom. $40.50 x 8 x 2					648	$648
	E. NDF Digestibility In Vitro Time Point Series (6 points) $237.00 x 8 x 2					3,792	$3,792
	F. Starch Digestibility In Vitro Time Point Series (6-Points): 2, 4, 6, 7, 8, 12, 24, or 30 hrs. Other time points may be available upon request. Needs to be run with Starch by NIR or chemistry. $285.75 x 8 x 2					4,604	$4,604
	G. Dry Matter Digestibility: In Vitro Per Time Point (6-Points) 4, 6, 12, 24, 30, 48, 72, 96, 120, or 240 hrs. $197.50 x 8 x 2					3,160	$3,160
	H. NDF Standard RPE Needs to be run with NDFom: Forage 4, 8, 12, 24, 48, 72, 120, and 240 hrs $316.00 x 8 x 2					5,056	$5,056
	I. NDF Standard RPE Needs to be run with NDFom: Ingredient 4, 8, 12, 24, 48, 72, and 120 $276.50 x 8 x 2					4,424	$4,424
	In Situ Analysis: CVAS maintains 10 to 12 cannulated lactating cows. This provides flexibility to hang large numbers of bags for in situ evaluations, at the same time having access to large amounts of rumen fluid for in vitro incubations. All In Situ Analysis will be performed on Composite Samples for 2-ranches and 8-samplings						$0
	A. MSPE, In Situ: Needs to be run with Crude Protein $207.50 x 8 x 2					3,320	$3,320
	B. Protein Digestibility In Situ: Rumen Undegradable Protein (RUP) at 16 hrs. $140.75 x 8 x 2					2,252	$2,252
	C.Dry Matter Digestibility In Situ Per Time Point: 24, 30, or 48 hrs. Other time points available upon request. $103.50 x 8 x 2					1,656	$1,656
	D. Starch Digestibility In Situ Per Time Point: 7, 16, or 24 hrs. Other time points available upon request. $127.50 x 8 x 2					2,040	$2,040
	E. NDF Digestibility In Situ Per Time Point: 6, 24, 30, 48, 96, or 120 hrs. Other time points available upon request. A request for a 72 hr or higher time point needs run with NDFom. $140.75 x 8 x 2					2,252	$2,252
	Amino Acids. All Amino Acid Analysis will be performed on Composite Samples for 2-ranches and 8-samplings						$0
	Full Profile with Tryptophan: Cysteine, Methionine, Lysine, Aspartic Acid, Threonine, Glutamic Acid, Proline, Glycine, Alanine, Valine, Isoleucine, Leucine, Serine, Tyrosine, Phenylalanine, Ornithine, Histidine, Arginine, and Tryptophan. $221.75 x 2 x 8					3,548	$3,548
	Mycotoxins: All Imicotoxin Analysis will be performed on Composite Samples for 2-ranches and 8-samplings						$0
	Detection Limit Aflatoxin B1 1 ppb Aflatoxin B2 1 ppb Aflatoxin G1 1 ppb Aflatoxin G2 1 ppb Deoxynivalenol (DON/Vomitoxin) 0.1 ppm Zearalenone 2.5 ppb Fumonisin B1 0.1 ppm Fumonisin B2 0.1 ppm Fumonisin B3 0.1 ppm T2 5 ppb HT2 5 ppb Ochratoxin A 1 ppb 3 Acetyl Don 0.1 ppm 15 Acetyl Don 0.1 ppm Citrinin 50 ppb Fusarenon X 0.5 ppm Nivalenol 0.5 ppm Neosolaniol 20 ppb Diacetoxyscirpenol (DAS) 100 ppb Price ..... $323.50 x 2 x 8						$5,176
	Soil Analysis @ $150+$25 S/H Costs @ 2 Ranches x 5 samples/ranch x 8 visits		14,000				$14,000
	S-NWS Lab Analysis Performed on 1 -Steer / 2 Ranches at 6 months and 12 months to coordinate with Carcass Analysis and Autopsy (meat samples provided to NWS Testing)						
	Purchase / Handling / Maintenance of Mated Female Screwworm Flies	1250					$1,250
	Purchase / Handling / Maintenance of Mated Female Screwworm Fly Eggs	1250					$1,250

Cost Category	Item Description and Quantity	Work Plan Objective 1 Total Costs	Work Plan Objective 2 Total Costs	Work Plan Objective 3 Total Costs	Work Plan Objective 4 Total Costs	Work Plan Objective 5 Total Costs	Total Budget
	Purchase / Handling / Maintenance of Mated Female Screwworm Fly Lavae	1250					$1,250
	Rental of Established Laboratory Space and Equipment for Testing	25000					$25,000
	Organic Chem Lab for VOC's, Phytochemical Repellents, Putrescine, Cadaverine (https://cialabs.com/) from Meat/Flesh, Hide, Blood, Gastric Juices, and Urine Samples						
	Odor / Color (OPPTS 830.6302 and 6304) @ $435/unit x 10-units x 4-carcass+1-control			21,750			$21,750
	Physical State (OPPTS 830.6303) @$435/unit x 10-units x 4-carcass+1-control			8,700			$8,700
	pH (OPPTS 830.7000) @ $515/unit x 10-Units x 4-carcass+1-control			25,700			$25,700
	Viscosity (OPPTS 830.7100) @ $1250/unit x 10-Units x 4-carcass + 1-control			62,500			$62,500
	Density (OPPTS 830.7300) @$830/unit x 10-units x 4-carcasxs+1-comtrol			41,500			$41,500
	Oxidation / Reduction (OPPTS 830.6314) @ $1250-Unit x 10-Units x 4-carcass+1-Control			62,500			$62,500
	UV – Visible Spectrum (OPPTS 830.7050) @$1878/Unit x 10-Units x 4-carcass+1-control			93,900			$93,900
	Melting Point (OPPTS 830.7200) @ $700/Unit x 10-Units x 4-carcass+1control			35,000			$35,000
	Boiling Point (OPPTS 830.7220) $1400/Unit x 10-Units x 4-carcass+1-control			70,000			$70,000
	Preliminary Analysis (OPPTS 830.1700)						
	1 Active by GC or HPLC @ $15,000 x 5-Composites			75,000			$75,000
	1 Active by both GC and HPLC @$17,500 x 5-composites			87,500			$87,500
	Characterization of an Active						
	1 Active by GC or HPLC, Active-GLP-C of A @$5750 x 5-composites			28,750			$28,750
	Beef Carcass Standard Lab Analysis $200/carcass x 4 steers x 2 ranches				1,600		$1,600
	Beef Carcass Physical Sepeartion Analysis $100/carcass x 3 steers x 2 ranches				800		$800
	Beef Steer S&H, Management Until Slaughter, Storage / Disposal $350 / Animal / Carcass x 4 steers x 2 ranches				4,600		$4,600
	Beef Steer Scoring / Grading / Analysis plus Beef Carcass Scoring and Grading $450 / steer x 2 ranches x 4 steers				6,600		$6,600
	Deer Run Ranch 2-steers for Carcass Analysis + NWS Test @ $4.00/lb at $1200/lbs on Hoof (Based on Current Price)			4,800			$4,800
	Walkabout Ranch 2-steers for Carcass Analysis + NWS Testing @ $4.00/lb at $1200lns on Hoof (Based on Current Price)			4,800			$4,800
Totals	**Other Subtotal**						**$1,064,595**
	Total Direct Costs						$1,194,769
	Indirect Costs						$0
	Total Project Costs						$1,194,769
	Less Cost Share - Recipient Contributions and In Kind Contributions						$72,000
	APHIS Cost Share / Total Funding Requested	**131420**	**98,670**	**723,224**	**84,270**	**178,024**	**$1,122,769**