Suction For Removal
Team: P.R.F.M.S. Vintage
Client(s): Cornell CALS Extension / E&J Gallo Winery / National Grape

Problem statement:
Grape growers are harvesting grapes for wine and juice production in upstate NY, but the presence of spotted lantern flies (SLFs) in the harvest introduces bitter, toxic quassinoids into the end product. Current methods of mechanical harvesting cannot effectively separate SLFs from the grapes, and as few as 1-2 SLFs per kilogram of grapes is enough to warrant rejection of a 22-ton load, requiring high precision for removal.

Impact:
- If less than 2 SLFs per 1000 grams of fruit are present in the collection bin, the clients will increase the amount of grapes sold, which will increase revenue and decrease product waste.
- If our solution can be effectively adapted to mechanical harvesting, growers will not need to resort to hand harvesting to reduce SLFs and can continue harvesting at the current pace.

Proposed direction(s):
Concept A: Conveyor Belt Vacuum
What it is: An overhead vacuum that would be attached above the conveyor belt after mechanical harvesting, but before it drops into the collection bin.
How it would be used:
- A conveyor belt would run under a vacuum, which provides just enough suction to pull in SLFs
- Would be after the fans on the conveyor belt (so only grapes, SLFs, and extra material)

Why it's better than the status quo:
- Adds another opportunity for removal
- Target SLFs when they are most vulnerable (not attached to vines)

End-of-semester proof-of-concept:
- By the end of the semester, we can design and 3D print a nozzle to adapt to a commercial vacuum that will be able to remove the SLFs without affecting the grapes, and machine a mount to attach the vacuum to the end of the conveyor belt.

Key risks/unknowns
Risk 1 — The vacuum needs to have very precise suction and a distance from the conveyor such that it picks up an object weighing 0.5-1g but not one weighing at least 5g. We can test this by using our prototype vacuum with different mass objects at the same distance.
Risk 2 — The vacuum may not pick up every item it targets and might be weaker in certain areas underneath it than in others. We can test this by having many objects around 0.5-1g pass under the vacuum and observing the success rate.

Questions for the client
1. How likely are dislodged SLFs from the harvester to cling on to grapes?
Decision affected: If this is the case, we need to implement a solution that dislodges the SLFs from the grapes before vacuuming.
2. How easy is it to implement a bulky solution like a vacuum on the conveyor belt that connects the harvester and the collection bin?
Decision affected: If it is not easy to implement a solution on the current infrastructure, we would have to modify the conveyor belt system as well.
3. How much material other than grapes remains after the fan stage?
Decision affected: If there are a lot of materials other than grape (MOG), we will have to alter the suction power to remove them because SLFs may cling onto debris.