I will attempt to answer some of the questions that are being asked about the perceived increased level of chemicals that are used in a Direct Seed (DS) production system.

The first and most important point to discuss is the need for rotation and the benefits of rotation to the DS system. No-till was introduced to the Northwest in the late 70's. The research and technology for rotation was not available at that time so the production was monoculture. In this area, that meant wheat on wheat continuously. That required increased levels of pesticides as weeds and diseases were amplified over a traditional tillage based system. That amplification of weed and disease pressure has not gone away when transitioning from a tillage system to a DS system it is just that the rotation deals with the problem. Rotation changes the ecosystem you are dealing with.
The key points to rotation are:

- Changes in types of crops such as warm season versus cool season and grassy crops versus broadleaf crops. Some examples are; wheat is a cool season grass crop and corn is a warm season grass crop and peas are a cool season broadleaf crop and sunflowers are a warm season broadleaf crop.
- Changes when crops are planted and when they canopy to compete with weeds. Our weed concentration has been predominantly cool season in nature because they coincide with what crop they co-habitate.
- Changes in the rhizosphere level of microbes and their ability to break down chemicals in the soil, to create natural pesticides and to create healthier soil and healthier crops. This comes from both the lack of tillage as well as rotation.
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These are just a few quick points to validate what I am going to discuss now.

The outcry from most people about the increased level of pesticide use can be from their knowledge of no-till in the 70's, Direct Seed systems with no rotation or, their outright disgust for Monsanto. The one chemical most often related to DS is Roundup which was the Monsanto trademark for glyphosate. I am not here to defend Monsanto or to trash them. Monsanto has undertaken a program to take control of crops from seed to finished product. Monsanto has developed crops that could greatly reduce starvation and malnutrition in third world countries. That being said, much of the dialogue against DS is actually directed at their dislike of Monsanto. Monsanto has lost their trademark and much of the glyphosate used today is not manufactured by Monsanto. Second, glyphosate has a very low toxicity level. It is broken down immediately upon soil contact, it is not used on growing crops as long as they are not GMO developed and therefore do not have an impact on Shepherd's Grain products since we are not allowed any GMO crops based on Food Alliance certification. Rotation from broadleaf to grass or vice-versa can eliminate the need for glyphosate in that year of production.

Rotation of crop types allows many different families of pesticides to be used therefore not creating immune biotypes of weeds. Again this may sound like more chemicals but it again decreases the need for increased toxicity levels to combat immune or resistant biotypes. Through the transition from a monoculture tillage based to a DS rotation system, this change in types of pesticides decreases the weed populations and results in a steady decline in amount and toxicity of pesticides used.

The change in when a crop is planted and when it canopies enough to compete with weeds for sunlight is another great aspect of rotation and directly reduces the need for pesticides. The sunflower for example creates such a canopy that no in-crop herbicides were needed because of the level of canopy and the timing of the canopy.

The microbial growth which is directly related to Direct Seeding is also aided by different crop types. They have differing appetites and different crops provide different nutrients for the microbes through decay of the plant. The microbes greatly contribute to health of the soil and resultant health of the crop. Microbes also create a pathway to breakdown harmful chemicals in the soil and potentially create beneficial components. Direct Seeding allows and

encourages the growth of a beneficial fungus on roots that grabs more natural nutrients from the soil than roots alone. Over time this results in a decreased level of fertilizers added and more coming naturally from the soil. Rotation of crop types impacts the rate of development of this fungus. Tillage kills this fungus. It can be added as a soil amendment but that is costly and therefore not sustainable as is creating it naturally.

Therefore, as soil health is improved through Direct Seed rotation crop production, there is a decrease in volume and toxicity of pesticides and a decrease in added fertilizers. This is a slow process as our soils in the Northwest have been tilled for over 100 years and therefore we should not expect this healing process to happen over night but it will happen with Direct Seeding and rotation.

Sustainability, as defined by Food Alliance, can be approached through this type of production system. We must continue to have a deep regard for the environment now and for future generations while producing healthy food for all of society today. It is our belief within Shepherd's Grain family of farms that Direct Seeding with rotation is the best available answer to sustainability today. An evolving nature, food consumers and producer driven science will tell us what the best available technology is tomorrow.