Application of Shot Blasting In Agricultural Sector

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Abstract: Shot blasting is a basically surface finishing process using high velocity steel abrasive, as in this process it is possible to obtain excellent cleaning and surface preparation for finishing operation. As this same principle is also applicable in case of agricultural sector by using air-propelled organic fertilizers as abrasive grits to control weeds and as well supplement for the crops to boost the plant growth. Mainly the abrasive-grits used for this was granulated walnuts shells, fertilizer grit and Soybean meal which were applied via compressed air on the crop, the 80-90% weed was totally converted into a biomass and yield of crop was upto 60 % greater than non-weeded crop. These abrasive weeding is mostly suitable for the transplanted plants and there was no effect on steam of plants of air-propelled abrasive grit on crops such as tomato, corn. Organic fertilizers were used as abrasive grits in this study which contribute Nitrogen to plant which improve the Functionality and marketability by abrasive-weeding.

1. Introduction

Shot blasting is a technique used for the purpose of surface finishing. Fortunately, it is a dust-free alternative and also saves on time and labor. With shot blasting there are none of the hassles associated with other methods used for surface preparation and you do not have to worry about expensive disposal procedures. In fact, shot blasting is fast becoming the preferred method among coating manufacturers since it produces great bonding characteristics that reduce instances of coating failure and increases floor life. Shot blasting is also used to remove scale, burrs, graffiti and rust from any surface.

As the same method is used in case of agriculture sector, in current situation most of the people are unaware about the technology used in organic farming. As most of organic crop growers keep confidence to increase productivity of a crop by expending more capital and labor for cultivation of soil, generally people use the handmade agricultural equipment’s which is the time consuming process which increases the cost and work of number of labor. In general people use hand sickle to remove and control the weed of an entire crop and in case of fertilizer the people dig the soil put the fertilizer and again put soil over it which is too time consuming process. In recent some organic growers also uses the plastic polyethylene mulching paper to reduce weed abundance and increase yields, beyond this some uses flame weeding which may be harmful for crops as well plastic paper so generally this process is avoided by organic growers so this is the general process used in case of farming in most of countries.

So the method which is used in shot blasting process same method is used in case of abrasive weed blasting, which involves using high pressure to blast fine bits of abrasives material of a fertilizer onto the surface of soil which destroys or kill the small weed completely without any damage to crop and converts into the biomass. In which the fertilizer grit also act supplement for the plants which increases the yield of crop and as well boost the growth of plant. Early field research on abrasive-weeding demonstrated the possibility for selective post-emergence control of small broadleaf weed seedlings within maize and soybean rows using granulated maize cobs as the abrasive grit (Forcella, 2012, 2013). Most research on abrasive-weeding has been focused in maize and soybean as the soyabean meal has 20% N which gives results for two-three months, but Wortman (2014) recently demonstrated that air-propelled abrasive grits has positive response in case of the growth of tomato or pepper (Capsicum annuum L.) in a greenhouse study (Wortman, 2014,2015). So this organic abrasive weed blasting technique can be implemented for an organic farming to improve crop yield and growth as well as increasing the productivity and marketability.

2. Literature review

Sam E. Wortman (2015) concluded that the two application of abrasive grit type and non-grit type, the weed density was reduced by 63% and 80% in tomato and peeper and the final weed biomass was reduced by 69-97% in weeded than in non-weeded plant. Broadleaf weed were more suitable than grass weed and after weeding the weed seedlings are located under the soil surface so it may grow again after treatment with abrasive grit or even by flame weeding. The results in abrasive weeding were good
than non-weeded crop and there was no negative effect on crops as well as marketability.

Virginia Nichols (2015) concluded that the principles of conservation agriculture, particularly crop rotation and surface residue retention, are in themselves method of weed control. The combined use of all three principles can offer disproportionate advantages, and weed problems are more likely to occur if only one conservation agriculture practice is utilized. For conservation agriculture, it appears the synergistic effects of utilizing multiple control tactics are even more crucial and their importance cannot be over-emphasized. With respect to weed control, no-till zero-tillage should never be implemented in monoculture systems and vice versa.

Sam E. Wortman (2014) concluded that the organic materials tested in this study, corn gluten meal, soybean meal, greensand fertilizer, and walnut shell grits demonstrated the greatest potential as air-propelled abrasive grits for weed control in vegetable cropping systems. These four materials provided the best POST abrasive weed control across both weeds and growth stages. Despite a few observed negative effects on crop growth, low application rates of most organic abrasive grits were compatible with tomato and pepper.

Frank Forcella [2013] concluded that Lack of treatment effects on third trifoliates and visual Inspection of plants suggested that all plants were recovering from abrasion by grit at the time of sampling, which was two weeks after the last abrasion treatment on V1 plants. Given sufficient time perhaps all treated plants would recover fully. This possibility was tested in the field experiments.

3. Methodology

This review started with discussion with guide. Then start to make & design best idea about title. Before that literature review & research about that subject is best to guide the idea. These tasks have been done through study on internet, books & journals papers.

Also Organic abrasive weed blasting is need now day’s in organic farming, because crop growers uses the old techniques in farming so they should be aware and start using such fast and time reducing organic farming technique.

4. Objective

The objective of this study was to determine the effect of air propelled abrasive grit type, including organic fertilizers, and application frequency on weed density and biomass and crop yield and marketability in organic vegetable cropping systems.

5. Working Principle

The process involves using high pressure to blast fine bits of abrasives material onto the surface.

It is a surface treatment process which involves protesting beads on the workpiece to change its surface state.

So as the same principle which is used in abrasive shot blasting is used in case of organic weed blasting for an organic farming.

6. Material and Method

6.1 Experimental design and crop management

Abrasive Weed control method generally used when the plant is transplanted from one place to another place and applied when the crop is reached to a particular leaf stages basically the height of plant should be 3-6 inch that is the five to six leaf for each plant. As this method was applied on the corn and tomato plant because the steam of such plants are much thicker so abrasive particle doesn’t effect on it according to field study.

The experiment for tomato seedling were carried on raised sand beds in which the distance between two centers of beds were taken as 0.61m apart and distance between three rows center were taken as 1.81m and bed covered with the polyethylene paper of 0.025mm silver-black plastic mulch paper and distance between two plants was 30cm with a hole on plastic paper of 10cm to cultivate seedling as well as for blasting purpose. As the tomato crop was drip irrigated which was placed under the plastic mulch paper and distance between two drippers was 15cm.

This drip irrigation system was used to supply fertilizers via drip to supply other liquid supplements. And the same experiment were carried for corn in which distance between two rows was 60cm and 30cm between two plants and no plastic mulch paper were used in case of corn and the applicational procedure were same for both crops.
6.2 Fertilizer abrasive grit application

The abrasive grit used were of 0.85 mm to 3mm which mainly depends on size of nozzle or less than this size based on the size of weed and crops. The abrasive grit with compressed air is propelled through nozzle with a pressure between 5.5 bars to 7 bar (80 to 100 psi) which is extremely high pressure. A high strength hose connected to the tank to a porcelain nozzle. The nozzle emitted grit in a full-cone pattern at a rate that was pressure dependent. The high pressure can be controlled by using certain control valves and released as per the requirement. The tractor were driven with a speed of 3.5km per hr. and second person walks at 0.9 m/sec behind the tractor carrying nozzle with a hose and weeds the fertilizer abrasive grit through nozzle at 4sec for each plant. Distance between tip of nozzle and soil surface is kept 30cm to 100cm and kept at a angle of 30 degree from the horizontal soil surface and 60 degree from the vertical i.e. upright corn plants. The size of nozzle was based on the fertilizer abrasive grit, and the process were continued over entire crop.

The abrasive weed used for this process was soybean meal, pigweed, urea (act as a strong fuel to uptake a plant and increase in speed of plant growth), granulated walnuts shells and maize cobs, greensand fertilizer, and soybean meal.

6.3. Components of system

1. Tractor
2. Air compressor
3. Air receiver tank
4. Abrasive grit storage tank
5. Nozzle
6. Hoses
7. Strong metal frame

7. Results and Discussion

The high air pressure with fertilizer grit completely destroy the grass weed which gets converted biomass and this converted biomass works as a fuel for plant which helps to increase growth stage of plant. The fertilizer grit is much more important for plant as it increases the strength of plant which gives 105 kg nitrogen per hectar and boost the plant for its growth.

Thus the abrasive weed blasting was more suitable for plastic mulch paper, due to plastic mulch the amount of weed was reduced about 70- 80% and only 10-20% weed was present around the plant of tomato. In abrasive grit weeded 69-97 % weed was totally converted into biomass than in non-weeded. In case of both application tomato and corn broadleaf weed density was decreased increasing the application frequency. Abrasive-weeding with three to four test increased fruit yield by 45% of tomato and corn and 33% of peeper. Crop yield was obtained during this process was upto 67 to 97 % benefit than the crops without weed blasting.

7.1. Other Benefits

Aside from just destroying weeds, you can help prevent more weeds and even fertilize the soil as you work. Using corn gluten meal as your grit can work to keep reducing weed population even after you’ve finished blasting, and it can double as a fertilizer. Soil too acidic? You can use lime as your blaster and help your soil at the same time.

7.2. Plant Safety

One of the biggest questions about using a method that shreds plant-matter is if it is safe for crops. Testing has found that spraying crops, such as corn, when they’re around 4-6 inches tall and then again around 1 foot destroys the weeds while leaving the crop unharmed.

Even when using this method on more delicate plants, such as tomatoes and peppers, the crops weren’t harmed at an unacceptable level. Even with some grit hitting the stems of tomato plants, the tops of the plants were still safe and intact, showing the future of this method to be very promising.

8. Advantages

1. 33 to 44% greater yields than in non-weeded control plots.
2. It does not affect the root of plant.
3. Low energy demands.
4. Reduces man work.
5. One or two person can handle the entire system.
6. Reduces grass weeding fertilizer spreading time.

9. Factors affecting weed blasting
1. Size of plant or crop
2. Size of nozzle
3. Velocity of abrasive grit
4. Size and shape of abrasive grit
5. Distance between two rows of plant seedling

**10. Conclusion**

The time required for abrasive air-propelled grass weed was reduced than the manual as well as simultaneously two combine operation were performed i.e. spreading fertilizer and converting the weed into biomass. In case two applications of abrasive grits, regardless of grit type, reduced total weed density by 63% and 80% in tomato and pepper, respectively. Broadleaf weeds gives more result to abrasive weeding than grass weeds. The organic weed blasting was most suitable for paper mulch crops. The yield of crop was increased by 45% than the non-weeded crop.

**11. References**

2. Sam E. Wortman,[2015] Air-propelled abrasive grits reduce weed abundance and increase yields in organic vegetable production, *Department of Crop Sciences, University of Illinois at Urbana e Champaign*, USA, 1201 Plant Sciences Laboratory, Urbana, IL 61801, USA Crop Protection 77 (2015) 157–162.

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