OPPORTUNITIES FOR CONSERVATION TILLAGE IN VEGETABLE PRODUCTION

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Conservation tillage plays an important role in reducing soil erosion and improving soil quality. Acreage under conservation till is rapidly increasing in recent years. USDA statistics indicates that over 100 million acres of farm land is now under conservation tillage. However, this substantial increase has made very little impact on the way growers produce vegetables. In the south, most vegetable production is still dependent upon high inputs and conventional tillage. There are number of reasons for lack interest in conservation tillage for vegetable production. Some of these reasons are:

- Lack of research on conservation tillage for vegetable production.
- Lack interest from vegetable researchers to work in this area.
- Too many crops, over forty vegetable crops are commercially grown in Georgia.
- It is difficult to take risks with 'High Value Crops' like vegetables.
- Research show that there is a yield reduction associated with conservation tillage in vegetables.
- Market windows require that crops be marketed during specific time.

Many growers who have switched to conservation tillage do not produce vegetables. But economic considerations are forcing them to look for alternative crops to maintain farming profitable. Some of these alternative crops are vegetables which remain profitable. Conversion from conventional tillage to conservation tillage saves $30 to $50 per acre. Not enough incentive to switch. Usual conservation tillage benefits like reduce erosion, improve soil quality, improve water holding capacity, etc. do not come with direct cost benefits. Only way to convince vegetable growers to show that it is a total system including cover crops, conservation tillage which will help them reduce tillage, fertilizer, and most pesticides. This will reduce off-farm inputs and thus. reduce production costs. Bottom line is the key. We have developed such systems in which conservation tillage is a key component.

PROGRESS OF RESEARCH

In 1985, we started our research on evaluating cover crops to improve soil and reduce pest pressures. The first year of trials, we evaluated 20 cover crops. Cover crops were planted in November. These over-wintering cover crops were strip-killed with glyphosate and then tilled. In the spring, various vegetable crops were planted in these strip-tilled plots. These strips were 12 inches wide and placed 3 feet apart on a bed with a 6-foot center. Cover crops in the middle and side of the bed were alive at the time of planting vegetables. As the season progressed these cover crops died. Herbicides and fertilizer were used as needed. No insecticides, fungicide, or nematicides were used. To our surprise, we observed less than 1% damage from insect pests and essentially there were no foliar disease problems. We continued this work for another year with the same results. Based on the success of our trials we applied for a Southern Region IPM grant to study the "Effects of Cover Crops on Weeds, Insect Pests, Diseases, and Nematodes on Vegetables." This research was funded for two years and was renewed for another two years. Four years of research involved 5 cover crops and fallow, followed by two double-crop vegetable rotations. During these six years the land was plowed in the fall before planting cover crops. Cover crops were planted every year. After 6 years of research with cover crops we learned that insect pests and foliar diseases were substantially reduced in a relay cropping system as outlined above. However seedling diseases and nematodes became a major problems in legume cover crops. We also observed similar problems on grower fields.

This ultimately convinced us to evaluate a conservation tillage system. Since 1991, a number of cover crops, followed by vegetable crops and agronomic crops have been evaluated. Since 1993, many of these rotations have been used by growers to reduce pest pressures and reduce pesticide use. These systems are environmentally friendly and economical feasible. Conservation tillage will improve soil quality and make it more productive and healthy.

Healthy (quality) soils, grow healthy crops. Healthy plants resist pest pressures more effectively. Excessive use of fertilizers and pesticides destroys the natural ecosystems and the plant's natural defenses. To reduce pest pressures

we need to work with nature and not try to control or destroy it.

HOW TO IMPROVE SOIL QUALITY, MAKE SOIL MORE PRODUCTIVE AND HEALTHY

The land which has been under trees and pastures for over 10 years, when brought into cultivation remains productive for 2-3 years. Bumper crops are raised in this newly opened soil with very little off-farm inputs in the beginning. As time goes by with more plowing and harrowing, organic matter is destroyed and higher off-farm inputs are needed to produce the same yields of crops. This increases production cost. This increase in off-farm inputs include substantial increases in pesticide use due to increased pest pressures.

Soil that has been under the cover of trees and pastures is not mechanically tilled which helps build organic matter which in turn improves soil structure and support high level of biological activity. This improves soil quality and productivity. Same results may be achieved by a shift in paradigm, that is by changing the way we till the soil. Adapt crop production to conservation tillage. By making this change growers will eliminate tillage operations which are detrimental to soil structure, soil organic matter, soil biological activity and indirectly soil productivity. These detrimental operation include plowing, disc harrowing, and use of rototillers.

CONSERVATION TILLAGE HOW-TO

Collect soil samples preferably in the fall. Get it tested. Apply all nutrients needed to bring levels to medium-high or higher. Adjust pH as needed. Lay-out beds. Plant selected over-wintering cover crops (small grains, legumes, etc.) during fall. In the spring, broadcast or strip kill cover crop mechanically or with herbicide. Cover crop residues and crop residues are left on the surface. Plant agronomic or vegetable crops. Crops raised under this system are not subjected to severe moisture and nutrient stresses and thus are healthy. These crops resist pest pressures better than conventionally grow crops. Conservation tillage system outlined above will help reduce pest pressure as presented.

Tillage

Successful conversion from conventional tillage requires proper planning and implementing those plans with precession. Many growers fail to plan ahead of time which ends up into an unsuccessful effort. How to plan and implement this conversion is briefly outlined above. Detailed information on successful planning and conversion to conservation tillage may be obtained from County Extension Service and Natural Resources Conservation Service.

Not-till delays vegetable harvest by two-three weeks and thus, strip-tilling is essential to harvest crops to coincide the market window.

Fertility

Conservation tillage help in reduction of nutrient losses due to erosion and leaching. Thus, it should be possible to maintain soil fertility by replacing nutrients removed by harvested crops. Our research and growers trials show that vegetable crops can be produced with reduced fertilizers in conservation tillage.

Weeds

Herbicides registered for use on vegetable are limited and thus, controlling weeds in vegetables in conventional production is difficult. It is even more difficult in vegetables grown in conservation tillage. Inadequate weed control reduce crop yields. It is possible to obtain excellent early season weed control in no-till system with rye or other cover crops with allelopathic ability. No-till delays harvests and is not a choice for vegetable growers with a limited market window. However. with proper planning growers may be able to obtain adequate weed control by utilizing following advantages derived from conservation tillage:

1. Reduced tillage and plowing leaves large number of weed seeds buried under.
2. Cover crop and crop residue form thick mulch which suppress weed germination.
3. Some cover crops like rye are allelopathic. Mulches of these crops are more effective in controlling weeds.

Insect Pests

Conservation tillage help provide habitat for beneficial insects and other beneficial organisms. It is however essential to develop planting schemes to provide year-round habitat for beneficials to derive maximum benefits.

1. Living, dead, and dying mulches provide habitat and food for beneficial.
2. Beneficial are in place on winter cover crops at the time of spring planting.

Diseases

It is difficult to explain as to why less diseases are observed on vegetables grown under conservation tillage.

1. Foliar diseases are substantially reduced in this system. No sandblasting, no injury to plants from cultivation and other effects on surface microflora.
2. Seedling diseases may be higher during the first year. However, incidence of soilborne diseases reduce drastically during succeeding years probably due to increase organic matter and increase beneficial soil

miroflora.

3. Reduction in viruses (e.g. tomato spotted wilt virus, squash mosiac, cucumber mosiac, etc.) May be due reduction in vector populations.

Nematodes

Conservation tillage also reduces nematode damage to vegetables. In some instances parasitic nematode population is reduced while in other situations damage reduction is without reduction in nematode populations.

1. Reduction in nematodes and/or nematode damage to crops probably due to increase in organic matter. It is possible to grow most vegetables in conservation tillage profitable by using 'Total System' as outlined above. Vegetable crops which have been raised with reduced inputs (fertilizers and pesticides) with cover crops and conservation tillage include, tomatoes, peppers, eggplants, cabbage, broccoli, watermelon, squash, cantaloupe, cucumber, beans, peas and okra. Most transplanted crops and large-seeded crops may be raised profitable using these systems. More research is needed with small-seeded crops which are direct seeded for example carrots, mustards, turnips etc.

A few growers have not only adapted these systems but improvised to make them profitable for the vegetable crops they are producing. More new growers are trying these systems. We are hopeful that more growers will see the value of these systems to make vegetable production more profitable and environmentally safe.

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