ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 5, May 2018

Multifunctional Mulching Machine Operations

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Abstract:-- **Plastic mulch layer Machine attached with a two wheel walking machine was designed and developed to help farmer who plastic mulch laying for control weed in bed. It consists of a main frame with hitching point, press wheels, plasticroll stand and disc plows.to start operation, lay plastic sheets on bed and then press wheels when two wheel walking machine move forward the plastic sheet will be pulled from the spool and laid on the soil bed, the both side of plastic sheet were buried by disc plows. Testing 3 model of plastic mulch layer machine include prototype model, the model of center of agriculture engineering practice nakhonsawan and the model of LG company in the watermelon field in prachinburi province. Average furrow bed size ws 1.05*0.52*0.23 meters(based bed x bed ridge x height). The result found that field efficiency were75.32,71.12 and 90.76 percent respectively and the efficiency of mulch were 94.68,94.68 and 62.0 percent respectively.**

I. INTRODUCTION

Picture the scene for the moment. An earthquake hits a city. Many homes and buildings are destroyed, survival for humans is difficult. People are trying to rebuild their communities after the disaster has torn down the walls of houses, damaged the streets and transportation networks, it will have destroyed water lines and other utilities, access to food is limited. Life would be tough. Some people would get sick, some would die. Aside from the immediate tragedy, societies would take a long time to rebuild. But this earthquake scenario happens every time we plough and till the soil. Complex communities of soil life are disrupted and destroyed. Worms are chopped, microbes exposed to the ultra violet sunlight, previous aeration and drainage channels are destroyed. Such damage and losses may have been a price to pay before the advent of the concept of Sustainable Agriculture and current worldwide population pressure, but is it acceptable for the future? The concept of needing to till fresh soil for crop production has long been in farmers' minds. Mentioned in the Bible the plough has long been held up as a symbol of successful and sustainable agriculture – and to a degree it has succeeded. But times have changed, technologies and science have developed in such a way that we are now able to understand that some of our traditional methods may not equip us for a sustainable future and they are in fact, extremely damaging.

Whilst travelling around the subcontinent I picked up a book written by a Japanese farmer Masanobu Fukuoka called "THE ONE STRAW REVOLUTION". Fifty years ago Fukuoka, a former agricultural scientist specialising in plant diseases, began questioning the basic principles Around which modern farming is organized. He advocated a system of natural farming. Its central tenets were that soil cultivation was immensely damaging and that good farming should imitate nature or natural processes. Chief amongst this is the idea that soil naturally clothes itself with a mat of dead or decaying vegetable matter – herein known as a mulch, and that crop production and the environment would benefit hugely from following this principle.

Fukuoka's model has never been taken up commercially and is likely to be limited on all but small scale farms, not least because he did not like using fertilisers or agrochemicals to help him, and therefore it was very labour intensive. My view is that whilst Fukuoka had valuable points about fertilisers weakening plant strength and pesticides contributing to some environmental problems, the benefits of adherence to "organic" principles are outweighed by gains from judicious use of external artificial inputs. Unbeknown to me at the time of reading the book, a revolution was, and continues to take place in South America and latterly parts of the USA. And frustratingly it has largely been ignored by subsidised Western European farmers. I went to visit pioneer farmers, researchers, extension staff and mavericks in Paraguay, Chile and the USA who have been perfecting systems of growing annual crops with minimum movement of the soil. Often viewed with a mixture of scepticism and suspicion by their peers, the people I had the privilege to meet are now finding that science and fellow farmers are at last catching up with them….

2. WHY THE MULCH?

A mulch is a layer of vegetation, dead, decaying or living, that acts as a protective cover over the soil. This has many

advantages for the soil and if you look around in woodlands, grasslands or anywhere where nature is left to its own devices you will find that nature is mulching itself. Always feeding, covering and protecting itself from the elements – and in agricultural situations we interpret these as weeds, green manures, crop and animal residues or grass leys.There is no doubt mulch is a bit of an amusing word especially if you keep repeating the virtues of the mulch in public! I have found you will attract a raised eyebrow from your peers when using it!Nevertheless this little appreciated biological process could be of great importance for future agricultural production and the politics of climate change

.There are many millions of hectares of direct drill farming in the USA, Canada and Australia. These tend to be simplified modern farming systems which save on soil erosion but do not necessarily make the best use of agro-ecological principles for nutrient, pest and weed management.Developments in South America and parts of the USA have been more exciting, they have adopted the principles of not tilling the soil and developed a more holistic approach, which allows great efficiencies. They have recognised that crop covers have a vital role in improving soil condition and fertility and they have looked in more detail at ways the plant cover interacts to provide a tilth in which seeds germinate, without any application of applied horsepower.

3. THE PROBLEMS OF SOIL TILLAGE.

The expansion of UK tillage based activities since the 1940's have increased the exposure of soil to the elements. Soil tillage has long been viewed as acceptable, or natural even. The more science tells us about the soil the more that we are discovering that the ground beneath our feet hosts a myriad interdependent organisms of which we knew nothing 30 or perhaps even 10 years ago. If I had a crystal ball and was respected enough for people to want to listen I would suggest that science will prove to us in the next thirty years that much of what we now view as the correct traditional way to grow crops is not so suitable in the future.Soil tillage confronts us with a number of issues which we are now struggling to manage sustainably – and we now need to consider seriously the concept of sustainability (and therefore Sustainable Agriculture) for it is written into our European and devolved constitutions. It is surely only responsible that we try and find a way not just to window dress existing agricultural practices but also to think more philosophically about the way we choose to produce?

For example soil tillage has implications for the following and the report will deal with each aspect:

- Soil Erosion
- Soil Quality
- Soil Structure
- Soil Fertility
- Soil Carbon

Soil Erosion

Erosion in agriculture results from any of several changes that remove the plant cover normally protecting the soil:

- Overgrazing
- Noxious weed Infestation
- Logging
- Tillage

Sometime in the last century soil erosion began to exceed new soil formation in large areas worldwide. In some parts of the world, farmland soils have been carried off by wind and water erosion at rates between 10 and 40 times the rates of soil formation. This has not been seen as a massive problem in the UK not least because we have been blessed with deep fertile soils. But soil erosion problems on farmland worldwide remain a fact and history is littered with examples of civilizations such as Norse Greenland and Minoan Crete whose collapse or serious decline, was triggered by an inability to maintain a fertile soil.\

In recent history area such as the US Great Plains it is like a small bomb and dislodges soil particles from the matrix. The first particles to be dislodged are the smallest colloids – these are the most fertile. Once dislodged they can easily be carried away.Climate change predictions claim that future rainfall patterns will lead to more intense but shorter bursts of rainfall, rather than gentle drizzle. This will cause more soil erosion pressure if not adequately dealt with.

Soil Quality

The most important factor in determining soil quality is soil organic matter. The organic matter consists of living organisms, fresh and decomposing residue. Soil organic matter is made up of about 60% Carbon. When the soil is opened up by tillage large amounts of Carbon Dioxide are released within a matter of days. This results in reduced organic matter and explains why it is very difficult to build up organic matter with tillage. Whilst the plough releases the greatest CO2 losses, lower losses have been recorded with minimum tillage. A No Till system can build organic matter. And a No Till Green

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
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Manure system with a sound rotation can build a lot of organic matter. Soil degradation affects 16% of EU land. Soil isn't soil without organic matter (OM) and in the UK some soils have worryingly low levels with an estimated 18% loss of OM between 1980-1995. In England and Wales a test on 6000 sites showed that there is 15% less Carbon in soils than 15 years ago.
Much topsoil OM is likely to have stabilised in the past ten years, but this may not be agronomically and ecologically sustainable for good yields in the future. We may need to focus on rebuilding this. There are also obligations on farmers to keep soil in Good Agricultural and Environmental Condition (GAEC – a cross compliance rule) and to do this they must satisfy three requirements:

- Maintain soil organic matter levels
- Reduce soil erosion
- Reduce damage to soil structure

The recently published Soil Atlas of Europe maintains that 75% of soils in Europe had OM content so low it is a cause for concern. Even with straw and crop residues OM can decline. Therefore we have a problem looming…

Soil Structure

A woodland or pasture has a natural structure. Different biological populations respire and operate at different depths and they all contribute to the soil as a living organism. Providing the soil has not been too abused by traction in wet weather, agricultural grassland will be well covered, naturally friable and reasonably resilient to flood and drought. A soil with a poor structure will have fewer fissures, less oxygen and more waterlogging. No till tries to emulate the structure of a pasture or prairie. Tillage over the years makes the soil unfit, and we spend time and energy knocking soil to create a tilth. Tillage destroys the structure of the soil leading to inevitable decline. Each time the soil is moved we destroy lots of mychorrizal and microbial interactions about which we are only starting to understand, but they do have a significant role in contributing to soil fertility. A good surface mulch keeps the worms busy and fed, – a well structured soil has enormous resilience. The earthworm has excellent drainage abilities. Worm casts have more nutrients than the soil itself and are pH neutral.

Soil Fertility

The macro nutrients for plant production are Calcium, Phosphate, Potash and Nitrogen. There is a burgeoning interest in the idea that Carbon, in the form of organic matter, should also be considered a major nutrient. Phosphate and Nitrogen are the predominant polluting nutrients often discovered in watercourses. A bare soil tends to lose the nutrients much more quickly and a healthy topsoil with a good surface mulch containing decaying, carbon-rich organic manure tends to keep nutrients in their place. Phosphate via reduced movement of soil colloids - which it clings to tightly, and Nitrogen via less leaching. Historically such losses of fertility have been little recognised, they have even been regarded as a necessary by-product of high yield crop production. In the meantime some of our very best soils have degraded, but the loss has been hidden by the use of plentiful affordable artificial fertilisers.
The aim therefore is to keep nutrients

a. in their place
b. recycling within the soil.

On a lot of the farms I visited Green manure covers were interspersed with the cash crops. In fact a lot of the farmers insisted that the seemingly nebulous idea of growing a crop merely to feed the soil was one of the key components to successful long term no tillage.

The Green manures perform various roles:

- Improve basic fertility of the soil
- Fix or lift nitrogen(and phosphorous)
- Weed suppression
- Pest control
- Soil improvement

The green manure tended to be destroyed by Glyphosate, but mechanical methods could be used and frost could play a part on warm season crops. Many Paraguayan farmers would use a homemade knife roller to crimp the stems of a cover crop. They would wait until the cover crop reached full flowering – ideally 50-75% bloom, the plant would have then expended its energy but its seeds would still be green and not viable. The stems would then be laid flat onto the ground and would be biological soil food.
One comment I heard was that green manures "appease natures desire for more biodiversity" and correspondingly there was good evidence to demonstrate that those farming a varied cropping system were spending less money than those trying to maintain a monoculture. With green manure covers, more lucrative crops may be grown with substantially lower input costs. Higher organic matter content can reduce the need for fertiliser by holding the nutrients in a non-leachable form, making fertilisers less polluting and more efficient.

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Soil Carbon

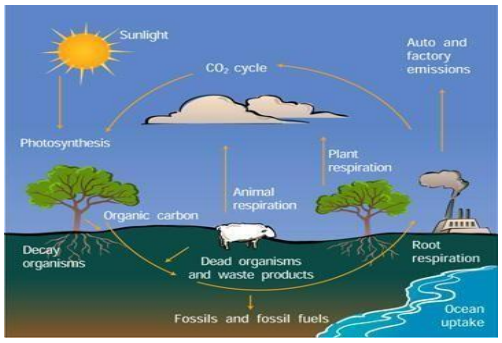

Fig 1.1 The Carbon Cycle

During my Nuffield study the profile of the climate change debate has risen inexorably. Firmly in the centre of the political debate now, it seems that certain issues pertaining to climate change and how to progress within a low carbon economy will dominate our society in the future. Climate change and carbon emissions have become the zeitgeist, how does agricultural crop production contribute and how can it mitigate carbon and other greenhouse gas emissions? Predictions of climate change in UK over the next 100 years are as follows:

- Warmer Temperature overall
- Milder, wetter Winters
- Hotter Drier Summers
- More Extreme Weather Incidents

There are two potential issues for agriculture here. One is being able to react to changes in a way that doesn't negatively affect their business and environmental obligations, and the other is to look at how farming practices can negate CO2 emissions. Scientists tell us, with 90% certainty, that the excess CO2 entering the atmosphere is causing climate change. Science is making progress in reducing CO2 emissions in the car, transport and energy industry but only agriculture and forestry can capture and reduce the CO2 currently in the atmosphere. Agriculture therefore has a significant role to play. The importance of soil carbon sequestration has been hitherto largely ignored, not least because the Kyoto protocol has focused on trying to get countries to think more about reducing the demand/ supply side of fossil fuel use.

In a no till operation with annual crops, the soil is disturbed very little. Earthworms and many other forms of macro soil life are not disturbed or destroyed. Micro soil life, along with the miles of ultra fine plant root hairs are not disturbed or exposed to damaging sun rays and oxidation, which can quickly destroy them. So all the time, the mulch, is helping build the fertile soil. In a natural environment the soil with its massive amount of Carbon based roots and other soil life is rarely exposed and destroyed.

4. SUSTAINABLE AGRICULTURE

The malleable concept of sustainability leaps throughout today's political landscape, I still don't know what it really means, and everyone has their own interpretation. The only way I felt I could properly get to grips with the political idea of sustainability, or more accurately Sustainable Agriculture was not to look at existing systems of crop production and think "how can I make this more green?" But to take a holistic look, and see how I could design my farming system to provide maximum environmental health and economic profitability. For example what system of crop growing would be the most fossil fuel efficient, and the cheapest? What would be the most ecologically benign for wildlife for watercourses? How can I save on soil erosion and make the best use of agro- ecological principles for nutrient, weed and disease management?Sustainable Agriculture for me, starts with the soil by seeking to reduce (or eliminate) erosion, make improvements to soil physical structure, organic matter content, improve its capacity to hold water or allow water to better percolate or allowing plants to access water when they need to use it. Soil health is improved through the use of legumes, green manures and cover crops; the incorporation of plants which have a capacity to fix N and reduce P losses from the soil. The extraordinary growth in No Tillage in the Americas, whereby a permanent organic cover over the soil provides a function of physically protecting the soil from the weather and feeds soil biota. The result is reduced soil erosion, improved OM and carbon content. Zero tillage systems using green manures and cover crops for mulches contribute to humus in the soil. The system also requires less fossil fuel for machinery passes.

5. MACHINERY

In No Till systems there are two immensely important bits of equipment – the drill and the sprayer. It is vital these are properly functioning for success.

Western hemisphere farmers tend to spend a fraction of what European farmers invest in machinery. Depreciation costs are a major difference. The benefits of no till are much greater for the user than the manufacturer. The manufacturer will sell a lot less steel and tractor horsepower when a farmer adapts to no till. As a

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consequence many drill manufacturers tend to focus exclusively on drills and do not have huge marketing budgets.

The most effective drill to use is a disc drill, such as the ones below:
This drill has double disc coulters which open a vertical slot in the soil, the seed is dropped between the opposing discs via a tube and then soil is pressed on top of the seed.

This drill only uses a single disc to open a vertical slot and a small seed boot runs in the ground dropping in the seed. Again a press wheel closes the opened slot. This is running wheat into a mustard cover crop on my own farm.

Tined drills do have a place in direct drill systems especially in Australia and Canada but in my view they are not adopting the agro- ecological potential of the mulch based system effectively enough. Tines cannot handle high residue very well and also tend to disturb more soil and therefore create more weeds. Poor machinery choice and a poor understanding of its operation is one of the main reasons for no till establishment failure. Though many farmers on my travels told me "its not about the drill its about the system."

One potential drawback of the system is that emissions of the greenhouse gas Nitrous Oxide have been recorded as higher in No Till systems.. More research is needed on this though but equally there is no reason why the problem could not be better managed in the future with different types of nitrogen sources. The problem is becoming more acute as focus of climate change develops. Recently some new information has been published that indicates that N2O may possibly diminish quite rapidly after the initial changeover years.
Furthermore if N doesn't leave the soil as a gas it could just as likely leave the soil as nitrate via leaching. The source of the N doesn't necessarily matter, suffice to say this is a new area that needs to be pursued with caution before drawing any conclusions.

6. CONCLUSION

What I was lucky enough to do on my 8 week trip to the Western hemisphere was to have the time to develop a clarity of thought, thanks to a consistent message from a range of successful farmers and researchers. These farmers were working in quite different environments and on different soil types. All reported genuine progress thanks to adopting mulch based agriculture and no tillage. It was enabling them to fulfil many of the tenets of what we require from sustainable agriculture. Each no till farmer tended to have a holistic viewpoint. One of them said to me "the decompaction zone is in the mind not the soil". Every farmer had a willingness to discuss nature and ecology as if it were the guide to helping them understand their farming system. interference. The average farmer does not understand the importance of not tilling the soil, at a structural or microbiological level – it

is an emerging science. In the meantime they could still enjoy its economic benefits and perhaps eventually other intangible benefits – better timeliness, less work and less stress.Sometimes mulch based agriculture is confused by sceptics as an ideology or some sort of religion. The people I met argue that it is nothing of the sort, but it is a consequence of an economic and ecological thought process. No form of agriculture will ever be natural but the nearest thing to nature in terms of grain production is no tillage, which mimics the annual cycle of the meadow, prairie or forest. Originally designed for soil conservation it has now evolved into a financially rewarding and sustainable production system. The challenge for the future is to maximise our agricultural output and at the same time minimise the effort and energy expended. Mulch based no till can allow us to do this, and it deserves farmer's attention and public support

7. REFERENCES

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