

Rotational No-Till and Mulching Systems for Organic Vegetable Farms

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<http://bodenfruchtbarkeit.net/>

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20.01.2015

(1)

WHY NO-TILL AND MULCH?

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Mimicking natural ecosystems. Both forests...

Always covered, living roots, diversity, little disturbance etc.

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{ 3 }



... and Prairies

Always covered, living roots, diversity, little disturbance etc.

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{ 4 }



Soil structure

Left under mulch cover – Right bare soil

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{ 5 }



Mit Mulch

Ohne Mulch

Weed suppression

Left under mulch cover – Right bare soil

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{ 6 }



Water management

Left under mulch cover – Right bare soil



Plant health

Left under mulch cover – Right bare soil

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{ 8 }



17.09.2013

Nutrient release
Roots in transferred clover grass mulch

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(9)



04.07.2013

Soil biology
Fungi on silage mulch

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Mulch System with Tillage

PLANTING INTO TRANSFERRED MULCH

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Integrating clover-grass in your rotation

But how?

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Seeding perennial clover grass mix together with winter hardy cover crop
Here clover grass mix with rye-vetch mix

(13)



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... chopping the cover crop for mulch once ...
Rye Vetch from the last picture; the following spring

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Clover grass develops after cover crop has been chopped off ...

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01.08.2013

... which can then be chopped for the coming two years several times.

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To be spread on cash crop fields...
Should result in an evenly thick layer of mulch

(17)



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Cutting mulch just before bloom for optimal C/N ratio
And no seeds in the mulch

(18)



Too fine

Optimal

Length of cuttings around 7-10 cm
Too finely chopped material can turn moldy and hinder air to soil contact

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(19)



Regular Tillage
Rotivator shallowly undercuts perennial clover grass in this picture = Conservation Tillage

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Transfer and spreading of mulch on cash crop fields
Should result in an evenly thick layer of mulch

(21)



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16.08.2005

Best results are achieved through a spreader with horizontal beaters

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Thickness of mulch around 7-10 cm
To achieve all season weed suppression

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Making sure the mulch is weed free
Or you're seeding meadow in your vegetable beds...

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Compacting the mulch layer
So it's an even mat

(25)



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Planting with high-residue equipment
Or manually by hand...

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Making mulch work

THE PLANTING EQUIPMENT

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(27)

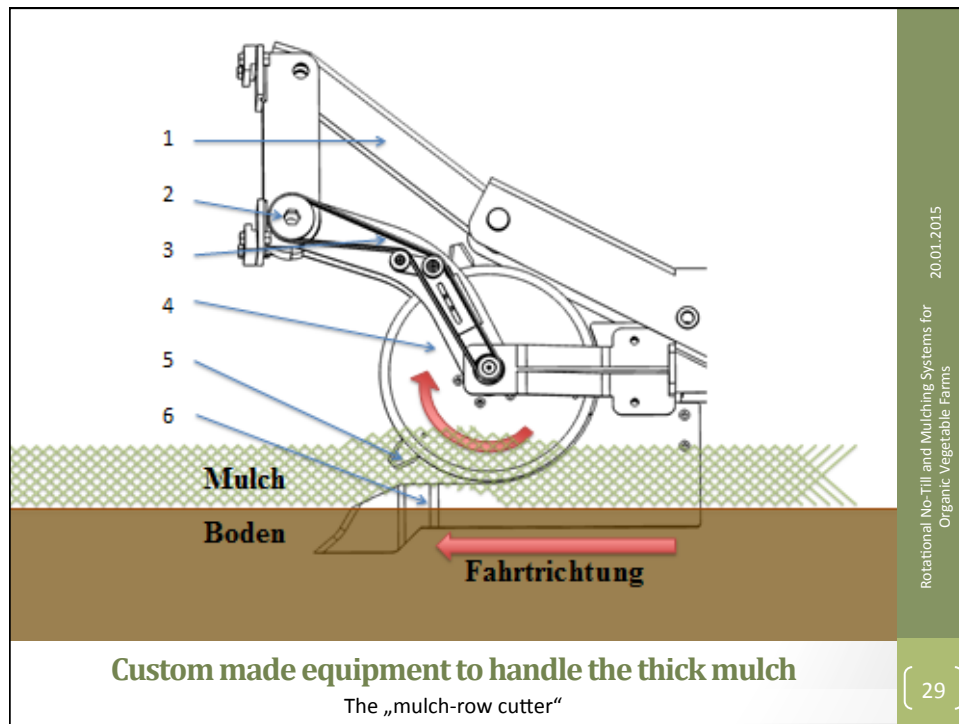


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Custom made equipment to handle the thick mulch

The „mulch-row cutter“

(28)



Making mulch work

THE FERTILITY

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N-fixation of clover grass - chop + drop (left) vs. chop and transfer (right)

- Chop+Drop: Clover becomes lazy: Total annual N-Fixation: 150 – 200 kg / ha
- Chop+Transfer: N-fixation improved. Total annual N-Fixation: 300 – 400 kg / ha

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(32)

				Nutrients in fresh material		
	Amount of fresh mulching material	Dry matter	C/N ratio	N	P205	K2O
	t/ha	%		kg/ha	kg/ha	kg/ha
grass	75	20	20	285	120	488
Clover	80	18	13	440	112	480
Clover:grass 30:70	75	20	15	323	105	465
Forage rye silage	50	30	38	235	115	245
Vetch:rye mix 30:70	40	30	25	184	64	240

Calculate necessary additional fertilizer in advance

- Depending on C/N ratio, up to 50 % of total nutrients in the mulch will become plant available in a give season (e.g.: 160 kg / N / ha)
- Amend necessary additional fertilizer before tillage, while planting or via irrigation
- Let labs analyze the nutrient profile of your farm specific mulching material

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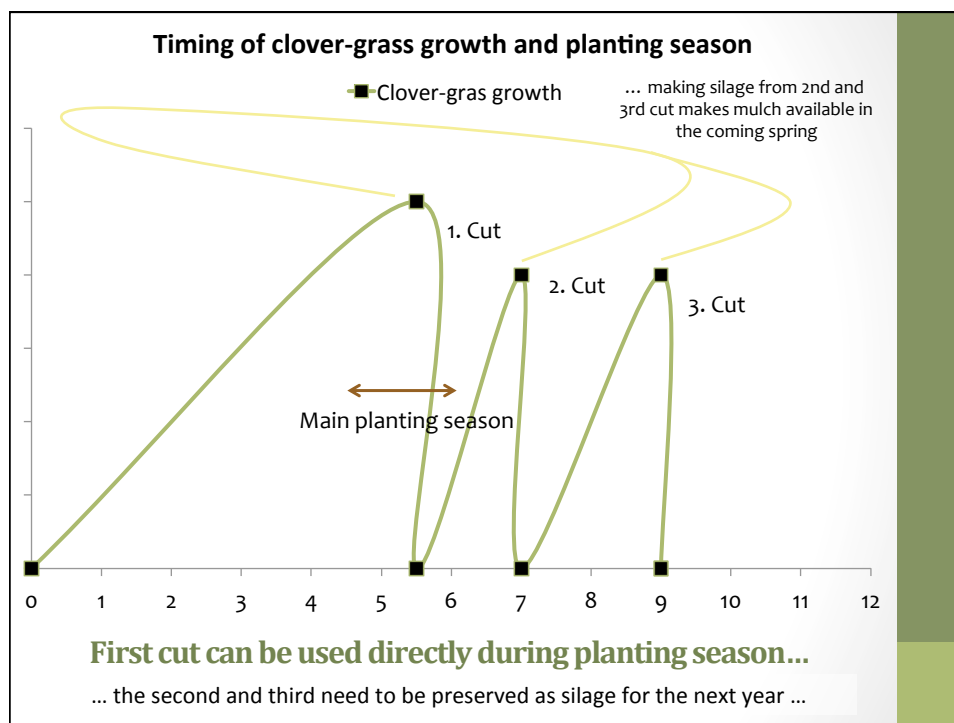
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Making mulch work

SILAGE AS KEY

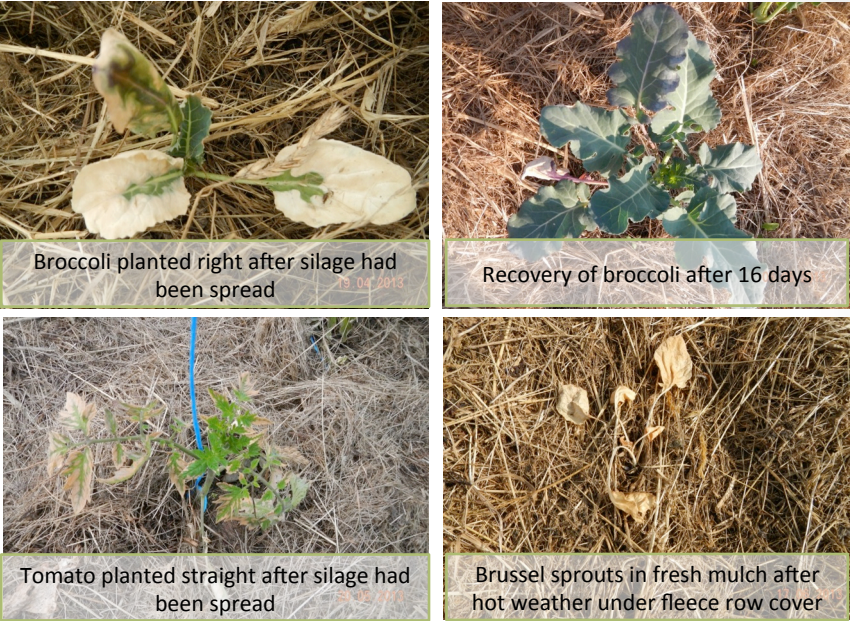
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(34)



Ratio Clover-grass Acreage to Cash Crop Acreage

- **Aim:** Covering cash crop acreage with a mulch of around 7-10 cm thickness
- As an overall average in Germany the cut from 1 acre covers 1/3 acre of cash crop acreage with mulch
- **Assumption:**
 - 3 cuts per year (average in Germany)
 - All of them are utilized for transferred mulch
 - This would result in a ratio of 1 acre of clover-grass to cover 1 acre of cash crop.



Broccoli planted right after silage had been spread

Recovery of broccoli after 16 days

Tomato planted straight after silage had been spread

Brussel sprouts in fresh mulch after hot weather under fleece row cover

Damage due to vapor from mulch

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{ 37 }

Summary Silage

- Equals out mulch deficit in spring and mulch excess in fall
- Flexible mulch source
- Weed seeds in mulch are killed by lactic acid fermentation
- Be aware:
 - Spreading silage early in spring insulates soil and lowers soil temperature
 - Vapor damage
 - Don't plant into silage right away. Either wait a week for vapor release or irrigate the whole surface before planting
 - Don't use fleece row-cover under warm conditions; even in fresh mulch
 - When using silage in greenhouse make sure you have good aeration

Making mulch work

WEED CONTROL

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(39)



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Mulch-Row-Cutter with wings as a sub-surface hoe / cultivator

(40)



Planting into transferred mulch

EXAMPLES

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(43)



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Beds nicely covered with transferred mulch

Compacted with roller-crimper

(44)



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Additional fertilizer: 80 kg of N; 40 kg of S
While we accounted for some nutrient release in our N-calculations

(45)



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Brussel Sprouts and other cash crops develop

(46)









No-Till Mulch System

ORGANIC NO-TILL WITH COVER CROPS

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Perfect and early seeding of cover crop

(56)





IF ALL OF THESE CONDITIONS ARE
MET...

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Kill cover crop at the first pod set / milk dough stage...

As shown in this picture for the mix mentioned before

(62)



04.06.2013

... with the right equipment...
Roller Crimper – Roll cover crop 2-3 times for optimal kill

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{ 63 }



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... to create a thick mulch layer ...
Again the Triticale mix...

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{ 64 }



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(67)



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(68)

A simpler set-up is possible compared to transferred mulch

If planting in the direction of crimping a sharp coulter in front of the planting show is enough...



A simpler set-up is possible compared to transferred mulch

Sub-surface tiller transplanter from Ron Morse of Virginia Tech

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(69)



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... while of course the more sophisticated equipment works too.

The „mulch-row cutter“

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(70)

Making mulch work

THE FERTILITY

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(71)



**Fertilizer box on transplanter feeds organic fertilizer into the
planting show, below the transplant.**

We don't expect any nutrient release from the crimped cover crop. So adjust fertility accordingly

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(72)

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WEED CONTROL

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(73)



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High residue cultivators work in this system as opposed to the transferred mulch
Should be readily available in the U.S.

(74)



Making mulch work

COVER CROP – CASH CROP COMBINATIONS

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(76)

Cover Crop – Cash Crop Combinations - Stacking

- Spring seeded cover crops
 - Summer planted cash crops
- Summer seeded cover crops
 - Fall planted cash crops
- Autumn seeded frost hardy cover crops
 - Late spring planted cash crops
- Autumn seeded frost killed cover crops
 - Early spring planted cash crops

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(77)

Organic no-till

EXAMPLES

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(78)









Best of both

COMBINING ORGANIC NO-TILL AND TRANSFERRED MULCH

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(87)



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Poor cover crop

Little biomass, weeds, not yet at right stage for rolling

(88)



Perfect soil structure still a pre-requisite though

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(89)



Flail mowing of cover crop...

Might lead to higher nutrient availability, due to chopped up cover crop, but to be on the safe side we didn't consider it in our calculations

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(90)



... means a faster decomposition of residue...
Leading to higher weed pressure if left as sole cover.

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(91)



Amending biomass through transferred mulch (less material needed!)
To create thick enough mulch for all afore mentioned benefits

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(92)





12.08.2013

Pumpkin in the combined system
Slower development on no-till plots at first (left and middle)

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(95)



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Pumpkin in the combined system
No-Till + Transferred Mulch treatments outyielded conventional tillage...

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(96)



A photograph of a pumpkin patch. Several bright orange pumpkins are visible among green leaves. Some leaves show signs of damage or disease, with brown spots and holes. A date stamp '16.10.2013' is visible in the lower right corner of the photo.

Pumpkin in the combined system
... due to healthier plants and less disease

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(97)

THE RESULTS

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(98)



30.05.2013

Soil structure below suitable cover crop for no-till
Again the Triticale-Mix

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(99)



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Soil structure still perfect after harvest
14 month no tillage

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(100)



30.06.2013

Build up of active soil organic matter
Higher grain cover crop on the left because of transferred mulch two years ago.

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(101)

Challenges in the System

- Management of the system as a whole is demanding
- Acreage reserved for cover crops and perennial clover grass is needed
- „Slower“ soils / less dynamic mineralisation from soils (especially if covered in spring)
- Perennial weeds can create problems
- Mice have shown up in 2014 as a major threat

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(102)



14.08.2013

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Thanks for your attention!

(103)

Resources

- Transferred mulch system
 - As for now, I am not aware of any resources in English
- High residue no-till systems in the U.S.
 - Ron Morse, Virginia Tech, See:
 - <http://www.extension.org/pages/18368/video:-weed-em-and-reap-part-2-reduced-tillage-strategies-for-vegetable-cropping-systems>
- Low residue no-till system in the U.S.
 - Natalie Lounsbury and Ray Weil
 - <http://notillveggies.org/>