Plants
Agroscope Fact Sheet | No. 31 / 2015

Growing green manures in greenhouse

Author: Vincent Michel

August 2015

Introduction

Green manures are seldom grown under shelter (glasshouse, tunnels). In such intensive and expensive production systems, there is no time and space to grow crops which do not generate an immediate benefit. Nevertheless, there are good reasons to grow regularly green manure crops in greenhouses.

Improvement of the soil structure

By the cultivation of several crops per year and the use of motor-driven soil tilling machines such as rototillers or spading machines (fig. 1) the soil structure of the top layer is repeatedly destroyed and the soil in the deeper layer is compacted. Growing deep-rooting plant species (crucifers, Sorghum-Sudangrass) can help to improve the soil structure especially in the lower layers.

Fig. 1: *Destruction of the structure of the top soil layer by a spading machine during a trial at Agroscope Conthey.*

Promotion of the soil life

Large amounts of easily degradable organic matter are added to the soil by the incorporation of green manures. Consequently, the activity of the soil microorganisms (fungi, actinomycetes, bacteria) is rapidly increased. These organisms do not only mineralize the organic matter to nutrients (available for the following crop), but they also form substances which can kill certain soilborne pathogens. A typical example are the group of *Streptomycetes*, where some species form toxic substances.

Toxic substances

Toxic molecules are also formed by different plant species. Their purpose is to protect the plant from pests or pathogens. Certain plant species used as green manure crops accumulate significant quantities of such molecules, especially high is their content in varieties selected for this purpose. Adapted to the temperate climate zones are mustard species with high contents of gluconsinolates and Sorghum-Sudangrass with high contents of dhurrin. During the degradation of the plants, glucosinolates are transformed to isothiocyanates and dhurrin to prussic acid. After the incorporation of the green manures, these toxic substances are released into the soil.

Practical hints for the cultivation of green manures in the greenhouse

In 2012 and 2013, the cultivation of green manures was tested in on-farm trials (Fig. 2) and at the Agroscope Research Centre Conthey. The goal of these trials was to collect information on the cultivation of different green manure crops in the greenhouse. The following data are based on these studies.

Fig. 2: *Brown mustard in April 2012 in a greenhouse of L. Favre, an organic vegetable grower at Saillon (Valais, Switzerland).*

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
Agroscope

Period of cultivation

The „dead“ season in greenhouse production in Switzerland is the winter season. Plant species which grow well at lower temperatures, such as cereals or crucifers, are best suited for this purpose. Plant species such as Sorghum-Sudangrass, which need high temperatures, should not be used during this period. In contrast, they are very well adapted to the high temperatures, which occur in the greenhouse during the summer season. A reason to grow green manures during the summer season is the much shorter growing duration. This is one of the results obtained in three trials (tab. 1) conducted in a greenhouse (Venlo type, fig. 3) at Agroscope Conthey. For the production of a similar amount of mustard dry matter, four months were needed in winter but only half the time i.e., two months, in summer. The cultivation in spring allowed also a reduction of the growing duration to two months. In case of rye, the cultivation in spring not only led to a shorter duration of the crop but also increased the production compared to the winter season. Growing mustard in summer did not increase the production compared to a spring cultivation. Sorghum-Sudangrass, which was only grown in summer, achieved an important increase in dry matter production compared to mustard.

Fig. 3: *Green manures grown in a greenhouse of Agroscope at the moment of incorporation (Sorghum-Sudangrass and brown mustard).*

The cultivation of these plant species was also tested in an unheated tunnel adjacent to the greenhouse. Production during the winter season was slightly lower in the tunnel, one more month was needed to obtain amounts similar to the greenhouse. In contrast, during the summer season differences were only small (Fig. 4).

Incorporation of green manures

Before the incorporation, the green manures have to be shredded. This was relatively difficult for the rye as a great number of the leaves were laying on the ground and were not picked-up by the mulching device. The Sorghum-Sudangrass was weighed down by the machine (Fig. 5) and consequently the stems were not shredded. By his erected growth type, brown mustard was shredded easily and without problems.

Other experiences

An important point for the successful cultivation of green manures in the greenhouse is the seed quality. A poor germination rate causes problems, especially for the weed suppression. Another problem is the occurrence of diseases and pests. In several trials, downy mildew appeared in the mustard plots (Fig. 6). This disease can destroy a crop in a very short period.

Fig. 4: *Sorghum-Sudangrass before the incorporation on 7 August 2013 in the greenhouse (left) and the tunnel (right).*

Fig. 5: *Sorghum-Sudangrass is weighed down by the mulching device, the stems are therefore only poorly or not at all shredded.*

Fig. 6: *Downy mildew of brown mustard caused by* Peronospora parasitica.

Conclusions

- The cultivation of green manures in the greenhouse during the winter season (October – February) needs 4-5 months. As the greenhouse is not heated, cold-tolerant species (such as cereals or cruciferous) have to be used.
- Growing during the mid-season (spring, fall) reduces the crop duration by half (~2 months).
- The cultivation in summer (June – August) needs 2 months. At this period it is possible to grow a thermophilic species such as Sorghum-Sudangrass. Which allows to increase drastically the production of green manures.
- Critical factors are the seed quality (suppression of weeds) and the high air humidity (occurrence of diseases such as downy mildew)

Table 1: Production of above-ground organic matter by green manure crops in a greenhouse (type Venlo) at Agroscope Conthey. The crops received no fertilizer, the threshold for irrigation was -70cbar. During the winter period, no heating occurred (only to protect from frost). Because of an irrigation error, the cultivation duration in summer (trial 3) was 9 instead of 7 weeks.

Trial	Plant species	Variety	Sowing date	Seed quantity (kg/ha)	Crop duration (days)	Above-ground fresh matter (kg/m^2)	Dry matter-content (%)	Above-ground dry matter (kg/m^2)
1	Brown mustard	Etamine	25.10.2012	9	118	6,7	7,0	0,47
	Rye	Borfuro	25.10.2012	180	118	2,7	14,0	0,38
2	Brown mustard	ISCI-99	7.3.2013	9	59	5.9	6,9	0,40
	Rye	Borfuro	7.3.2013	180	59	4.2	11,9	0,50
3	Brown mustard	Etamine	14.6.2013	10	63	6,6	7,2	0,47
	Sorghum-Sudangrass	Susu	14.6.2013	20	63	7,8	11,7	0,91
	Sorghum-Sudangrass	BMR-201	14.6.2013	20	63	11,8	10,1	1,19

Impressum

Editor:	Agroscope Research Centre Conthey (VS) Route des Vergers 18 1964 Conthey www.agroscope.ch
Information:	vincent.michel@agroscope.admin.ch
Editorial:	Vincent Michel
Copyright:	© Agroscope 2015