EFFECT OF PLANTING DATES AND CUTTING STAGES ON THE PRODUCTION OF FIVE SELECTED WINTER CEREALS IN MOLOTO DISTRICT GAUTENG AND NOOITGEDACHT IN MPUMALANGA PROVINCE.

FULL DISSERTATION SUBMITTED IN PARTLY FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN AGRICULTURAL MANAGEMENT (PASTURE SCIENCE),

BY

P. N. RAMASELELE

[redacted]

DEPARTMENT OF PLANT PRODUCTION, SOIL SCIENCE AND AGRICULTURAL ENGINEERING, SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES, FACULTY OF SCIENCE AND AGRICULTURE, UNIVERSITY OF LIMPOPO, TURFLOOP CAMPUS, SOUTH AFRICA

SUPERVISOR: PROF C. S. DANNHAUSER

CO-SUPERVISOR: DR J.J JORDAN

OCTOBER 2014

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DECLARATION

With the grace of the lord, God thee Almighty I here by declare that the work herein submitted as dissertation for the degree Master of Agricultural Administration. The work herein is authentic and no plagiarism was done. This work has never been presented as a dissertation at this campus or elsewhere.

Signed at ……………………………….

Signature:………………………………..

ACKNOWLEDGEMENT

NRF (NATIONAL RESEARCH FOUNDATION) funded the research. I am highly indebted to my supervisor Prof C.S Dannhauser and co-supervisor Dr J.J Jordan for the organization and the efforts in my research and dissertation writing. Other people‘s contribution towards this dissertation was acknowledged by the form of citations. I would dearly like to thank the following people for their contribution towards my project. Firstly and far most I would like to thank Christ our Redeemer for blessing me with wonderful friends, family, colleagues and lecturers. By saying that, this people were my knights in a shinning amour: Professor C. S. Dannhauser, my wife T.S Mamabolo, my parents Mrs/Mr N.M and K.S Ramaselele and my only grandmother M.M Sekowe. It would be a great sin if I don’t mention my two fellow students, Ngoasheng M.A. and Choshi N. E.

ABSTRACT

Due to shortage of adequate pasture in large parts of South Africa, winter survival poses a problem to farmers. A shortage in winter grazing is the major problem on most farms in South Africa. Animals loose weight in winter which leads to low reproduction, production of milk, mutton and meat. The winter feed shortages counteract also the possible good performance of animals during summer. Winter supplementation contributes largely to high input costs in livestock production, which can make this enterprise uneconomically.

This study was done at two different localities: Hygrotech's experimental farm at Dewageningsdrift, Gauteng and Nooitgedacht Agricultural Development center, Mpumalunga.

Five winter fodder crop cultivars (Witteberg oats, Overberg oats, LS 35 stooling rye, LS 62 stooling rye and Cloc 1 Triticale) were planted on six planting dates (05 April, 04 May, 06 June, 20 July, 20 August and 26 September). Five cutting treatments were applied on Dewageningsdrift:

- First cut 8 weeks after planting and after that re-growth every six weeks (Ct 8),
- First cut 10 weeks after planting and after that re-growth every six weeks (Ct 10),
- First cut 12 weeks after planting and after that re-growth cut every six weeks (Ct 12),
- First cut 14 weeks after planting and after that re-growth cut every six weeks (Ct 14),
- First cut when more than 50% of plants were in the reproduction stage (RS).

The same cultivars that were used at Dewageningsdrift were used on Nooitgedacht ADC. Only one planting date was applied here that was 02 February 2007. The cutting treatments differed also from that on Dewageningsdrift. Material was cut for the first time when it reached a grazing stage (± 50-60 cm high) and after that re-growth was measured four weeks.

The main conclusions from the study were that, Witteberg oats has retained its nutritional value longer than other cultivars.

LS 35 stooling rye was an early or short duration growing cultivar, if planted in February to April it will provide grazing early/Mid-winter. However it can also be planted in July to grow in spring.

LS 62 stooling rye is a medium to long duration growing cultivar which optimum production period will be in late winter and spring.

Witteberg oats is a medium/late producer and a long duration growing cultivar, thus if planted early (April) it can provide grazing until late winter.

Overberg oats is an early/med long duration growing type, if planted in April it will produce mid-winter, planted in May to July it will produce late winter and planted in August it will provide spring grazing.

Cloc 1 triticale is a long duration growing type. It will produce late winter when planted in April to July and in spring when planted in August/September.

CHAPTER 1

INTRODUCTION

1.1 THE HUMAN POPULATION IN SOUTH AFRICA

The population growth between 1976 and 2011 in South Africa has increased. With a population growth rate among the highest in the world, the population is expected to double within the next two to three decades. The growing human population will place an increasing pressure on the natural agricultural resources and we have to work for food security (Pretorius *et al*, 1976).

1.2 IMPROVED ANIMAL PRODUCTION FOR THE FUTURE

1.2.1 Need for better roughage production with special reference to winter.

According to Dannhauser (1991) shortage of adequate, good quality herbage during the winter months is one of the biggest problems confronting the stock farmer in the summer rainfall areas. Animal scientists agree that poor winter feed is responsible for the generally low animal production in South Africa. In the lower rainfall areas where sweet veld is available during winter, feeding of animals is less of a problem because quality is less of a problem but here quantity presents the biggest problem. In crop production areas (high rainfall area) farmers rely on crop residues, especially maize, to a large extend for winter survival, but this is not possible in Limpopo Province with its low rainfall. In general, provision of fodder for the late winter and autumn remains a problem. Besides crop residues and rested veld, livestock farmers in Limpopo Province could also use conserved foggage, hay and silage (Van Zyl, 2006). Farmers with irrigation or limited irrigation can make use of winter cereal crops like oats, rye and Triticale for winter feeding, which was the topic of the this study.

1.2.2 Livestock farming in South Africa

Livestock production is the most important agricultural activity in South Africa and accounts for more than 40% of the total value of the agricultural output (World Bank 2002, as cited by Anon 2004). Beef cattle producers vary from highly sophisticated commercial farmers (who rely on high technology) to communal subsistence producers (who rely on indigenous knowledge and appropriate technology). Two major groups of beef cattle farmers therefore co-exist in South Africa (Anon, 2004), namely:

a) The commercial beef producer, with production relatively high and who compare well with developed countries. Commercial beef cattle production is generally based on synthetic breeds and crossbreeding, using Indicus/ Sanga types and their crosses.
b) The emerging beef cattle farmer, who own or lease land, cattle generally consist of indigenous crossbred types.

Both sectors are characterized by limited financial resources, land and technical skills. In the higher rainfall areas of South Africa, many farmers normally face a decline in quality of forage in autumn, after the summer grasses have reached maturity. Winter cereal crops such as oats (*Avena sativa*), triticale (*Triticale hexaploide*) and rye (*Secale cereale*), are cultivated under both irrigated and dryland conditions to meet this need. Most of the rye grown in South Africa had the disadvantage of producing seed in autumn and is then less acceptable to grazing animals. Where irrigation is available Italian rye grass (*L. multiflorum)* is also used especially for dairy cattle and fat lamb production (Bruckner & Raymer, 1990).

1.3 PROBLEM STATEMENT

Due to shortage of adequate pasture in large parts of South Africa, winter survival poses a problem to farmers (Dannhauser, 1991). A shortage in winter grazing is the major problem on most farms in South Africa. Animals loose weight in winter which leads to low reproduction and low milk, mutton and meat production. The demand for high animal production as an alternative way to conventional, intensive rearing of animals has increased globally in recent years (Nilze'n *et al*, 2001; Walshe *et al*, 2006, Shongwe *et al*, 2007).

The difficult winter feed shortages counteract the possible good summer performance of animals leading to sub-optimal animal reproduction. Winter supplementation contributes largely to high input costs in livestock production, which can make this enterprise uneconomical (Broom, 1995).

- Drought

In an intensive farming system, such as a dairy, it is not really possible to use stock reduction to mitigate the negative effects of a drought. If there are a few unwanted animals on the farm, they should be sold first. However, the focus should rather be placed on alternatives for the most limiting resources, probably feeds like silage and hay, and irrigation pastures (Broom, 1995). The best mentioned option to be recommended was tested in this study.

- Expensive supplement feeds

With profit predictions, it soon becomes apparent that it is profitable to run certain classes of livestock on high cost pastures. For example, it is highly profitable to produce milk or to fatten lambs on irrigated Italian rye grass even though it can cost as much as R9000/ha, annually (Broom, 1995). On the other hand, it is also obvious that there are situations when it just does not pay to use high cost pastures. As an example, it is in uneconomical produce wool on irrigated Italian rye grass (Fair, 1989).

1.4 MOTIVATION FOR THE STUDY

The study will improve the knowledge for both commercial and smallholder livestock farmers, in mid to high rainfall areas in South Africa or under irrigation. It is especially applicable to use winter cereal such as triticale oats and rye can provide farmers with valuable alternative forages and can be used to extend the traditional grazing season into the early spring and late fall and to produce winter fodder, who have limited irrigation available. The study included six planting dates that started in April; the last one was in September. That was specifically done to evaluate late planting dates in a season with low rainfall up to December and high rainfall during late summer and autumn.

The emphasis of this study was to look into the effect of planting date and cutting treatment on the growth and re-growth of three different winter cereal species and five different cultivars. The production of winter cereals is extremely expensive but gives good results in the fattening of lambs and dairy, because of high palatability and productivity. Although expensive, even small scale farmers can use limited areas of green grazing. This could be economically for high producing livestock under good management.

Good management of planted pastures includes efficient establishment, fertilization, utilization and harvesting of fodder crops (Amman and Pieterse, 2005). One of the biggest challenges for the animal industry is the selection of crops that will be able to produce in most areas of South Africa with limited irrigation. It is further important to choose the correct cultivars, the correct planting date and the correct utilizing stages of the fodder crop. The winter grains, as a group, can perform an important function as green fodder during winter in South Africa, especially for higher producing animals (Dannhuaser, 1991).

CHAPTER 2
LITERATURE REVIEW

2.1 THE NEED FOR INCREASED ANIMAL PRODUCTION

Nutrient requirements for different classes of livestock should be considered when selecting species and cultivars for forage production. Differences in growth characteristics can affect the feeding value of the forage. For example, Maloney *et al*. (1999) reported that winter sensitive cereal crops had higher neutral detergent fiber (NDF) and lower crude protein (CP) concentrations in the autumn, compared with winter- hardly cereal species. The winter-sensitive cereals grew more actively and had elongated stems in the autumn, whereas the winter- hardy cereals comprised primarily of leaves (McCormick *et al*, 2006).

With the increasing food demand for an increasing human population, there is a need to increase the productivity of each hectare of agricultural land without degrading the natural resources of the country. The most direct way of achieving this on land set aside for animal production, is to increase livestock numbers. This provides only a short term solution to the problem and will have a negative effect on resources. Veld alone can not provide for such increases in production. The most logical, and in the long term most profitable means of doing this, would be to convert appropriate areas into pastures. Currently there is little economic incentives to increase production levels in South Africa due to the introduction of large-scale importations of a number of agricultural products. Any measures which need to be taken to increase food production locally will inevitably lead to an increase of future areas under pastures (Tainton. 2000).

2.2 WINTER FEEDING FOR LIVESTOCK IN GENERAL

2.2.1 Foggage

Foggage is a cultivated summer growing pasture which is grazed or cut during the first part of the growing season. Thereafter, it is left to grow out during the second part of the growing season. In the dormant stage the pasture is then grazed as foggage or standing hay. Usually a palatable summer growing grass is used. It is important that such a grass should maintain its palatability and nutritional value to present a good foggage. Examples of grasses in low summer rainfall areas are *Digiteria eriantha*, *Cynodon dactylon*, and *Cencrus ciliaris*. In the very dry parts of the country, *Anthephora pubescens* is well adapted and offers a good quality foggage, with a leaf material content of 80% and higher and good chemical qualities (Van Zyl, 2006).

Shortage of adequate, good quality herbage during winter is one of the biggest problems for stock farmers in the summer rainfall areas. Animal scientists agree that poor winter feed is responsible for the low animal production in South Africa (Dannhauser 2001). In the lower rainfall areas, where sweet veld is available during winter, feeding of animals is less of a problem. In the crop production areas farmers rely, to a large extent, on crop residues, especially maize, for winter survival. Never the less, provision of fodder for the late winter and autumn remains a problem. Besides crop residues, hay and silage is also well known fodder sources for winter feeding. Both are, however, relatively expensive if it is used for extensive farming such as beef cattle. Over the popular method to overcome winter shortages was the use of foggage.

2.2.2 Crop residues

Crop residues offer great potential as a relatively cheap feed source for the livestock industry and is sometimes regarded as crucial for livestock survival in winter (Crichton *et al*. 1998 as cited by Van Zyl 2006). However, Van Zyl (2006) quoted that farmers have withdrawn more marginal soils from cash cropping due to the following limiting factors:

- A price –cost squeeze in cash cropping.
- Climatic risk like short, severe droughts, especially in Limpopo.
- Soil restrictions, like acidity build up and aluminum toxicity.

This has resulted in a reduction in the availability of crop residues for livestock. Became abandoned crop lands are either left to revert to secondary succession again or established with planted pastures. Minimum tillage cultivation practices on grain crop lands are gaining in popularity.

These practices inhabit the utilisation of residues to a large extent, and this contributes further to the decrease in residues available for livestock (Van Zyl, 2006). In most parts of the semi-arid areas of South Africa, maize residues make an extremely important contribution to the forage requirements of the animals during winter. However it is difficult to obtain adequate crop residues in the Limpopo Province, due to unpredictable low rainfall (Tainton, 2000).

2.2.3 Hay

According to Engelbrecht *et al*, (2004), hay plays an important part in most fodder-flow programs. Hay production requires higher financial inputs than foggage. Because of high running costs, hay should be used for high-producing animals or when no other grazing is available. Hay is usually fed in the late winter months before the veld is ready for grazing. When hay is produced, the correct species must be used, it must be cut at the right time and correct fertilization must be practiced. The choice of species depends on the environment, availability of irrigation and type of animal.

2.2.4 Silage

Engelbrecht *et al*, (2004) indicated that in regions where winters are cold and dry, it is common to conserve forages. Silage is made of seasonal surpluses (mainly of maize) that occur on most intensively farmed farms. The advantages of silage above that of hay, is that it is less dependent on the weather, has no fire hazard and quality is maintained for a longer period. The disadvantages include a poorer intake of dry matter, higher transport costs and lower acceptability to young animals.

2.2.5 Irrigation of winter growing planted pasture

Irrigated pastures have been used with great success in the past, but in the Limpopo Province it is limited due to the cost and poor availability of irrigation water (Tainton, 2000). Research indicated that even the use of irrigated planted pastures for autumn lambing ewes has declined in popularity due to increasing input costs (Viljoen, 1996). However, it is important for dairy cattle and fat lamb production. The growth of any crop under irrigation is an expensive undertaking and it must be well planned and managed.

In general, irrigated pastures are managed in much the same way as rain fed pastures. It is important to remember that the high yields of well fertilized and irrigated pastures must be effectively utilized in order to cover the high costs involved. Pasture irrigation is therefore usually confined to intensive operations such as milk production and fat lamb production (Donaldson, 2001).

2.3 PREVIOUS EXPERIENCE WITH WINTER CEREALS AS PASTURES IN SOUTH AFRICA

Cronje (1980) and Van Heerden (1981) did research on the grazing and production potential of winter cereals for dairy cattle and sheep, respectively.

Cronje (1980) found that, on both rye and oats, an average of 15.6 ℓ milk per cow per day was possible. The milk production per ha per year on these crops was 2227 ℓ/ha and 1987 ℓ/ha, respectively (Table 2.1). He further quoted that oats, triticale, wheat and rye did not have a significant influence on weaning mass.

Table 2.1: Milk productions of two winter grains (Cronje, 1980).

	Rye	Oats
Milk (*l*/day)	15.6	15.6
Milk (*l*/ha)	2227	1987
Butter fat %	3.66	3.58

According to Table 2.2, there were no significant differences between the weaning mass and carcass mass of mutton merino lambs when feed all four winter cereals. On wheat the after weaning growth was the lowest, but the most grazing days were obtained from it.

Van Heeden (1981) showed (Table 2.3) that the daily gain of beef cattle was the best on rye (940g/day) and that the total gain per animal was 97 kg over a period of 104 days. Rye grazing resulted in better animal production compared to maize silage and oats.

Table 2.2: Growth rate of S.A mutton merino lambs (Cronje, 1980).

	Oats	Triticale	Wheat	Rye
Weaning (kg)	18.0	18.2	19.0	19.0
Carcass mass (kg)	35.8	36.0	32.8	35.7
Mass gain (kg)	17.8	17.8	13.8	16.7
Grazing days	2177	2260	2704	2514

Table 2.3: Weaner (beef) productions from silage and forage (Van Heerden, 1981)

	Silage	Rye	Oats
ADG (g)	810	940	790
Gain (kg/animal)	85	97	77
Feeding period (day)	106	104	100

The general shortage of winter pasture in large parts of South Africa poses a problem to farmers. The winter grains as a group can perform an important function as green fodder in winter, as shown by Cronje (1980) and Van Heerden (1981), especially for higher producing animals. There are, however, a number of limitations to the cultivation of green fodder for winter in some areas, this will be discussed later.

Excellent performance levels have been reported for animals grazing small grain pastures. In a comparison study between wheat, winter rye and triticale forage in a beef cattle finishing program, Petel and Nishimuta (1978) reported average daily grains (ADG) of 1.29, 1.41, and 1.01 kg per head, respectively. Animals also received considerable (and variable) quantities of energy supplements. Kilcher and Lawrence (1979) reported an ADG of 0.59 kg for steers grazing winter rye pastures in Saskatchewan that were not supplemented .

The fattening of lambs depends on the lambing season. In the case of the autumn lambing season, fattening should take place during August to October. This will most probably take place in the feedlot or on an irrigated pasture. In the case of an ox production system, the animals are marketed at the age of 18 to 24 months. After weaning (in April), young steers must survive the winter without loosing mass to be fattened quickly during the following summer. Dairy cows must be fed good quality pastures for the full lactation period. It must be taken into account that there will be lactating cows throughout the year. It is possible to fully provide for the cow's need with high quality pasture (Dannhauser, 1991).

2.4 WINTER CEREAL PRODUCTION

2.4.1 Present knowledge on the agronomy of winter cereals

The choices of winter cereals and cultivars largely depend on the rainfall and/or soil moisture conditions during February and onwards. In the summer rainfall areas soil moisture must be conserved, from January onwards or even earlier if possible to ensure successful establishment (Donaldson, 2001).

The following winter cereals are more drought resistant (Donaldson, 2001) and were included in the study,

2.4.1.1 ***Triticale hexaploide*** **(triticale)**

Donaldson (2001) stated that triticale is a hybrid derived from crossing wheat (*Triticum sp*.) with cereal rye (*Secale sp*.). It is regarded as the first "man made" winter cereal that is commercially grown. The market is small when compared with other winter cereals, as it must compete with barley as the preferred winter feed grain. Although *Triticale* usually flowers earlier than wheat planted at a similar time, grain filling takes longer and grain size may suffer problematic if the late season is hot and dry. Its re-growth takes long because it is a late type winter cereal (Donaldson, 2001).

2.4.1.2 **Fodder Rye**

Rye is an erect annual winter cereal with greenish blue, flat leaf blades and an extensive fibrous root system. Rye is extremely winter hardy, grows late into the autumn and is quite tolerant to drought (Fohner, 2002). Rye can grow on infertile soils where other cereal grains would normally fail.

Rye is widely adapted and highly versatile forage used for pasture, green chop, silage, hay and as a cover crop (Fohner, 2002). Small grains like rye are excellent crops for grazing, particularly prior to reproductive growth (Fohner, 2002). Cereal rye also fits into a year-round grazing system because of its early season production (Moyer and Coffey, 2000).

Anther characteristic of rye is that it has a high forage production when compared to other cereal grains such as triticale, wheat and barley (Watson *et al*, 1993). The same authers also found that rye produced a higher yield than other cereal grains. However, cereal rye constantly accumulated more forage than rye between January and March, which led to greater yields in late winter.

Although rye offers many positive attributes for grazing, it does have disadvantages. Researchers found that pastures of rye and wheat matured early in the grazing season (early April). Subsequently, animals lose weight and condition earlier than with other winter cereals (Gunter *et al*, 2002). Rye declines in quality due to its earlier reproductive stage it becomes unpalatable earlier in the spring than other cereals (Watson *et al*, 1970).

Beside soil moisture, suitable soil temperature is also a requirement for optimum seed germination and seedling growth. Most tropical and subtropical species require a soil temperate of at least 10^{o}C for effective seed germination and seedling establishment. Temperature species (winter cereals) will germinate and establish at soil temperatures of 5^{o} C (Carpenter *et al*, 1990).

2.5 THE MANAGEMENT OF PLANTED PASTURES

The success or failure of a pasture program is largely dependent on the management applied. The management includes factors like establishment, fertilization, irrigation and utilization. The actual grazing or defoliation of the fodder crop is also important and determines the productivity of the pasture and the performance of the animals utilizing it. However, there is no universal system of grazing (defoliation) management to suit all pasture species or all animal production systems. Pasture species differ in many respects and these differences need to be taken into account when planning a grazing programme (Tainton, 2001).

2.5.1 Intensity and timing of utilization

The degree to which a pasture is grazed during a grazing event is referred to as the intensity of grazing. The greater the intensity of grazing, the greater the rate of forage utilization and the greater the harvesting efficiency. In a practice, grazing intensities are evaluated, based on the relationship between pre-grazing and post-grazing forage height (Fox, 1992).

In early spring, pastures growth rate are extremely high and if the pastures have not yet been grazed, are fairly uniform. If forage heights are allowed to reach the 8 to 10 inch target heights prior to the first grazing, a large percentage of the pasture will be past its prime quality in a very short period of the time. It be so tall that much of it will be trampled and wasted (Fox, 1992).

2.5.2 Pasture condition

The re-growth of pastures that comprise of largely of young tillers and a dense population of young leaves at the base of the sward, will normally be fast if a reasonable amount of leaf remains after utilization (thus not overgrazing). The remaining leaves should be photosynthetically active and will contribute to rapid re-growth. If most of the tillers are reasonably old, the basal leaves will be too old to contribute substantially to photosynthesis if they alone remain after grazing. Similarly, if the pasture has been at full canopy for any length of time, the basal leaves (even relatively young tillers) will degenerate and will not recover if because of the shade effect of the full grown sward (Tainton, 2000). Therefore is little point to leave too much effective leaves on such pastures after grazing (Tainton, 2000). In short, under utilization can be just as harmful as over utilization.

2.5.3 Growth rate and pasture utilization

The higher the re-growth rate of a pasture, the more frequently it should be defoliated. Frequent light defoliation allows for unrestricted intake, a rapid re-growth, high quality of herbage for livestock and ensures that the pasture does not remain at full canopy (over grown) for any length of time. In addition, frequent light defoliation guarantees a large residual leaf area. High growth rates are associated with high rates of photosynthesis, providing the potential for 'surplus' carbohydrates for the development of lateral tillers. Of particular significance during such periods of abundant pasture is wastage. In practice, high growth rates imply the need to introduce additional animals or reducing the number of camps in the grazing system. Camps that are excluded can be used by other animals or for the production of hay or silage (Tainton, 2000).

Sustainable utilisation targets of 40–48% are suitable for areas with an extended dry period greater than 150 days and very little summer feed on annual grass-based pastures or clover-based pastures. The dairy industry is achieving pasture utilisation levels of 65–70%; however, dairy farms are generally located in a longer growing season zone or have irrigation and can supplementary feed with grain very easily. In a beef situation, the cost of supplements (hay or grain) often comes directly off the bottom line and there is a significant period of little or no pasture growth. The level to which pasture utilisation can be improved in a beef enterprise depends on enterprise type (ie breeding herd versus trading enterprise), length of dry period and pasture type. In a beef trading enterprise, pasture utilisation of 50–60% is possible in most environments, if limited stocks are carried over the dry period. In a breeding operation, a sustainable pasture utilisation of 40–55% is possible, depending on pasture type. The first point is to maximise the amount of pasture grown, allocate the feed to the correct livestock class and determine the level of utilisation that fits your environment and production system (trading versus breeding enterprise) (McPee *et al***,** 1995).

CHAPTER 3

MATERIALS AND METHODS

3. EXPERIMENTAL SITES

The research was done at two different localities in two different provinces

3.1 DEWAGENINGSDRIFT(DWD)

Dewageningsdrift is the Hygrotech Seed Company's Experimental Farm and is situated along the R 573 route between Pretoria and KwaMhlanga, approximately 5 km from Moloto village. The co-ordinates and location of the experimental farm given in Figure 3.1. While the Long Term Average (LTA) meteorological data of the Animal Production Institute, Roodeplaat (ARC) stated in Table 3.1, The Institute is approximately 10 km from DWD. The soil varies from sandy to sandy-loam and at the South western corner of the farm loose stones do occur.

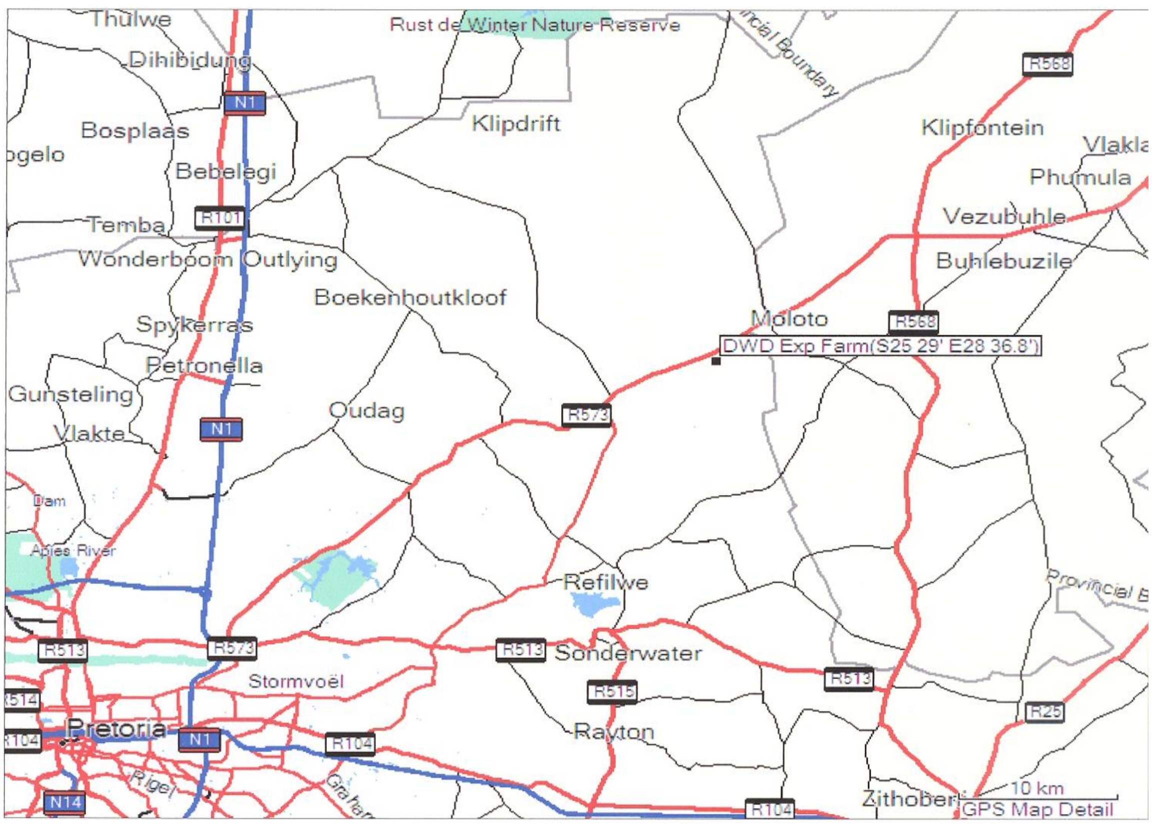

Figure 3.1.1: The position and co-ordinates of the Dewageningsdrift

Table 3.1: The long term average (LTA) meteorological data for Animal Production Institute, Roodeplaat (ARC)

	Frost (days)	Rain (mm)	Rel Hum. Min (%)	Rel Hum. Max (%)	Temp Min (ºC)	Temp Max (ºC)
Jan	0.0	140.5	36.9	87.8	17.0	29.7
Feb	0.0	94.7	34.3	88.0	16.6	30.2
Mar	0.0	61.2	34.6	88.0	15.0	29.1
Apr	0.0	28.9	31.8	89.8	11.3	27.0
May	1.3	15.9	25.3	87.3	5.8	24.1
Jun	0.8	9.2	26.2	87.5	3.9	21.7
Jul	3.9	1.9	19.8	82.1	2.3	22.2
Aug	1.0	4.8	19.7	79.2	5.7	24.9
Sep	0.1	6.0	17.4	75.7	9.2	28.2
Oct	0.0	59.9	23.9	79.5	13.5	29.7
Nov	0.0	55.9	30.4	84.8	15.3	29.6
Dec	0.0	83.4	32.4	87.0	16.4	30.1
Annual	7.1	562.3	332.8	1017.6	132.0	326.5

Average first frost: 29 May
Average last frost: 25 August
Average frost season: 58 days
Average frost days/year: 7 days
Percentage years with frost: 100.00

According to Table 3.1 frost occurs during May to August with the highest intensity in July. Temperatures of below 10ºC (LTA) occur from May to September with the lowest of 2.3ºC in July. The warmest months are October to March with a long term average ranging from 29.1- 30.2ºC. The LTA rainfall is 562.3 mm per annum. It peaks from October to March, with the highest (140.5 mm) in January.

3.1.1 Experimental design

The experiment on Dewageningsdrift was done in 2007 and three main treatments were used:

- Six planting dates
- Five annual winter fodder crops
- Five cutting treatments.

Planting dates

The six planting dates were randomly distributed in six large blocks over the Experimental Farm. The same fodder species and cutting treatments were used in the six large blocks, however the statistical analysis were done separately for the different planting dates. The planting dates were:

- 05 April 2007 (PD1)
- 04 May 2007 (PD2)
- 06 June 2007 (PD3)
- 20 July 2007 (PD4)
- 20 August 2007 (PD5)
- 26 September 2007 (PD6)

The layout within each large block (planting date) was a randomized block design with split-plots. Fifteen plots were used for each planting date (large block): 5 fodder crops x 3 replications (small blocks). The five plots (fodder crops) in each replication (small block) were randomized and each plot was divided into five sub-plots (not randomized) to apply the six cutting treatments.

Winter fodder crops

Three different winter cereals (including five different cultivars) were used in the experiment:

Two oats (*Avena sativa*) cultivars:

- Witteberg oats (C1)
- Overberg oats (C2)

Two stooling rye (*Secale cereale*) cultivars:

- LS 35 stooling rye (C3)
- LS 62 stooling rye (C4)

One *triticale (Triticale hexploide)* cultivar:

- Cloc 1 triticale (C5)

Cutting treatments

Five cutting treatments were applied in the five split plots:

- Sub-plot A (Ct 8): Was cut initially 8 weeks after planting, and after that regrowth was cut every six weeks.
- Sub-plot B (Ct 10): Was cut initially 10 weeks after planting, and after that re-growth was cut every six weeks.
- Sub-plot C (Ct 12): Was cut initially 12 weeks after planting, and after that re-growth was cut every six weeks.
- Sub-plot D (Ct 14): Was cut initially 14 weeks after planting, and after that re-growth was cut every six weeks.
- Sub-plot E (Ct RS): Was cut when more than 50% of plants were in the reproductive stages.

The abbreviations in brackets ( ) will be used for the rest of the discussion.

3.1.2 Plot dimension and layout

The individual plots (fodder crops) were 1.5 m x 7.0 m (10.5m^2) in size. The subplots were 1.5 m x 1.0 m, with 50 cm spaces between each sub-plot.

3.1.3 Seed bed preparation

The soil was ripped loosen the land, followed by a disc plough cultivation. Thereafter, a disc harrow used to prepare a firm, fine seedbed.

3.1.4 Fertilization and Irrigation

Before planting the equivalent of 150 kg/ha 2:3:4 and 250 kg/ha Rapid raiser were applied and disc in. Rapid raiser is an organic fertilizer made of chicken manure with 30g/kg N, 30g/kg P and 30g/kg K + micro elements. A nitrogen top dressing was applied in two portions four weeks after planting and again 8 weeks after planting. In each case 125 kg LAN (28%) was applied. Irrigation of 20-25 mm/week was applied for the full growing period with an overhead sprinkler irrigation system. Irrigation was given according to rainfall and was less in February/March when rain was received (Table: 3.1). During autumn and winter the 20-25 mm/week was applied.

Photo: 3.1: The photo represents one block (replication) with the five different cultivars.

3.1.5 Data collection

The cutting treatment data (as described in paragraph, 3.1.1) was cut in a 100 cm x 100 cm square. The time of the first cut in each sub-plot (A to D) is given in par: 3.2.1.2. Re-growth on each sub-plot was cut at intervals of six weeks starting from the first cut that was applied. The sub-plots were hand cut to a height of 5cm.

3.1.6 Data analysis

Data was analysed using the statistical program GenStat® (Payne *et al*. 2009). Results were compared against each by using an ANOVA and the Fischer's protected LSD and were done separately for each planting date.

3.2 NOOITGEDACHT ADC ERMELO (MPUMALANGA)

The Nooitgedacht Agricultural Development Center (NADC) is situated approximately 7 km outside Ermelo (Mpumalanga) along the R39 route to Morgenson and Standerton. The location and co-ordinates of the experimental farm is given in Figure 3.2, while the Long Term Average (LTA) meteorological data is given in Table 3.2. Acocks (1975) defined the vegetation as Northeastern Sandy Highveld with sourveld and the soils are predominantly of the Wasbank form (MacVicar *et al*, 1977). The area is well known for its cold winters and warm summer days.

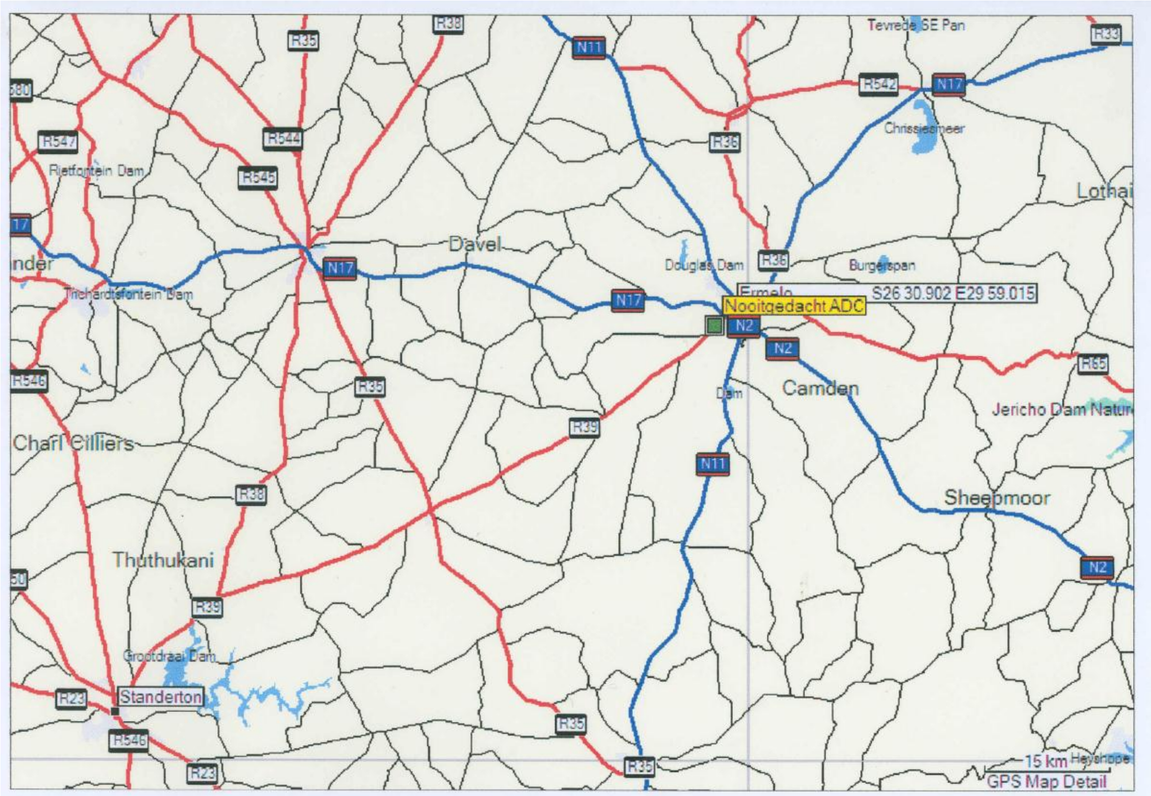

Figure 3.2.2: The position and co-ordinates of the Nooitgedacht (ADC)

According to Table 3.2 temperatures of below 10ºC (LTA) occur from April to October with the coldest of 0.2ºC in June and July. The warmest months are October to March (LTA: 23 to 24.7ºC). The LTA rainfall is 703.4 mm per annum and peaks from October to March, with the highest (126.8 mm) in January. Frost could occur during winter.

3.2.1 Experimental design

The same cultivars that were used at Dewageningsdrift were used on Nooitgedacht Agricultural Development Center (ADC). Only one planting date was applied which was 02 February 2007. A randomized block design was used, with five winter fodder crops in randomized plots and three replications (blocks). The five cutting cycles were not used as cutting treatments and were only used to illustrate a seasonal production trend. The material was cut initially when it reached grazing stage (± 50 - 60 cm high) and after that re-growth was cut every month (4 weeks).

Table 3.2: The long term average (LTA) meteorological data for Nooitgedacht ADC Farm, 2007 season (Table 4.1)

	Rain (mm)	Temp Min (ºC)	Temp Max (ºC)
Jan	126.8	13.3	24.7
Feb	72.7	12.9	24.2
Mar	68.8	11.4	23.6
Apr	35.3	8.0	21.5
May	10.5	3.7	19.2
Jun	7.8	0.2	16.6
Jul	6.6	0.2	17.1
Aug	12.9	3.0	19.5
Sep	27.1	7.1	22.9
Oct	91.4	9.5	23.0
Nov	114.4	11.2	23.4
Dec	129.0	12.5	24.3
Annual	703.4	93.0	260.0

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3.2.1.1 Treatments applied:

Winter fodder crops

Three different winter cereal species and five different cultivars were used in the experiment which included:

Two oats (*Avena sativa*) cultivars:

- Witteberg oats (C1)
- Overberg oats (C2)

Two stooling rye (*Secale cereale*) cultivars:

- LS 35 stooling rye (C3)
- LS 62 stooling rye (C4)

One *triticale (Triticale hexploide)* cultivar:

- Cloc 1 triticale (C5)

3.2.2 Plot dimension and layout.

The size of each plot was 2 m x 8 m (16m^2) and the data was collected in a sub-plot of 7x1 m (7m^2), with 50 cm spaces between each sub-plot.

3.2.3 Seed bed preparation

The soil was ripped loosen the land, followed by a disc plough cultivation. Thereafter, a disc harrow used to prepare a firm, fine seedbed.

3.2.4 Fertilization and Irrigation

Before planting the equivalent of 150 kg/ha 2:3:4 and 250 kg/ha Rapid raiser were applied and disc in. Rapid raiser is an organic fertilizer made of chicken manure with 30g/kg N, 30g/kg P and 30g/kg K + micro elements. A nitrogen top dressing was applied in two portions, four weeks after planting and again 8 weeks after planting. In each case 125 kg LAN (28%) was applied. Irrigation of 20-25 mm/week was applied for the full growing period with an overhead sprinkler irrigation system. Irrigation was given according to rainfall and was less in April/May, when rain was received (see Table: 3.2). During autumn and winter the 20-25 mm/week was applied.

3.2.5 Data collection

The material was cut with sickle bar motorized machine with a cutting width of 1 m. The cutting height was 8 cm. The length of the strip that was cut was 7 m per plot, which meant a plot size of 7m^2. The area outside the experimental strip (of each bigger plot) was cut directly after each data collection. During the season which started in May 2007 and ended in September 2007 five cuts per plot were made.

3.2.6 Data analysis

Data was analysed using the statistical program GenStat® (Payne *et al*, 2009). The data was acceptably normal with homogeneous treatment variances. Treatment means were separated using Fisher's protected t-test least significant difference (LSD) at the 5 % level of significance (Payne *et al*, 2009).

CHAPTER 4:

RESULTS AND DISCUSSIONS

4.1 DEWAGENINGS DRIFT (DWD) (GAUTENG) RESULTS

4.1.1 Metrological results

The monthly long term average (LTA) metrological data for the 2007 season, at the Animal Production Institute, Roodeplaat (ARC), is shown in Table 4.1. This research station is about 20 km from Dewageningsdrift and the nearest weather station with LTA weather data.

Table 4.1: Climatic data for 2007 at the Animal Production Institute, Roodeplaat
(Source: ISCW, Agromet Section, Private Bag X79, Pretoria 0001)

2007	Period	Rain	FD	RHx	RHn	ETo	Rs	Tmax	Tmin	U2
January	1 - 31	60.7	0.0	85.9	25.0	6.1	27.0	31.7	15.9	1.1
February	1 - 28	27.9	0.0	81.0	18.3	6.5	27.3	33.8	15.8	1.3
March	1 - 31	7.2	0.0	78.3	21.0	5.5	23.1	32.1	14.8	1.2
April	1 - 30	12.5	0.0	85.8	23.1	4.0	18.8	28.5	11.5	1.1
May	1 - 31	0.3	4.0	76.5	14.7	3.2	18.4	24.9	4.4	1.0
June	1 - 30	30.1	2.0	85.5	23.6	2.5	16.1	21.4	3.3	1.0
July	1 - 31	9.4	3.0	78.4	18.3	2.8	17.2	21.4	2.2	1.1
August	1 - 31	0.0	0.0	71.9	16.4	3.9	20.9	24.8	4.5	1.3
September	1 - 30	36.3	0.0	69.4	16.9	5.1	24.0	30.2	11.3	1.2
October	1 - 31	150.9	0.0	88.1	38.7	4.6	21.0	25.7	13.3	1.3
November	1 - 30	55.1	0.0	88.3	35.3	5.2	23.2	28.5	15.0	1.2
December	1 - 31	149.3	0.0	88.7	38.6	5.4	25.6	27.9	15.5	1.0
Total		539.3								

KEY NOTES:

Rain	mm/day	Rainfall
FD	days	Frost Days
RHx	%	Maximum Daily Relative Humidity
RHn	%	Minimum Daily Relative Humidity
Rs	MJ/m²/day	Radiation
Tmax	ºC	Daily Maximum Temperature
Tmin	ºC	Daily Minimum Temperature
U2	M/s	Wind Speed

According to Table 3.1, the LTA rainfall in the area is 562.3 mm, while it was 539.3 mm for the 2007 season (Table 4.1). The rainfall for the first 6 months of 2007 was only 138.7 mm, which was lower than the LTA of 350.4 mm (Table 3.1). During the period July to December

2007 the total rainfall was 401 mm, which was higher than the 211.9 mm of the LTA for the same period.

4.1.2 Results obtained from the 5th April 2007 planting date.

In Paragraph 3.2.2 (Chapter 3) all treatments were described in detail. For the rest of the discussion the following terms abbreviations will be used for the different treatments:

Cultivars:

Two oats (*Avena sativa*) cultivars:

- Witteberg oats (C1)
- Overberg oats (C2)

Two stooling rye (*Secale cereale*) cultivars:

- LS 35 stooling rye (C3)
- LS 62 stooling rye (C4)

One Triticale (*Tricale hexploide*) cultivar:

- Cloc 1 triticale (C5)

Cutting treatments:

- Ct 8: Cut initially 8 weeks after planting and re-growth every six weeks.
- Ct 10: Cut initially 10 weeks after planting and re-growth every six weeks.
- Ct 12: Cut initially 12 weeks after planting and re-growth every six weeks.
- Ct 14: Cut initially 14 weeks after planting and re-growth every six weeks.
- Reproductive stage: Cut once at the reproduction stage.

4.1.2.1 Total dry matter production (DM production)

Table 4.2 represents the total DM production (initial cut + re-growth) of plots that were planted on the 5th April 2007. The statistical analysis of the data is given in Appendix A.1. The initial cutting dates for the different cutting treatments were: Ct 8 on the 31st May; Ct 10 on the 14th June; Ct 12 on the 28th June and Ct 14 on the 12th July 2007.

According to Appendix A.1 the interaction between cultivars and cutting treatments influenced DM yields significantly ($P \leq 0.001$). Cultivars and cutting treatments (as main effects) both had a significant influence on DM production $P \leq 0.026$ and $P \leq 0.008$, respectively.

Table 4.2: The influence of cutting treatment on the total DM (t/ha) production of the different winter pasture cultivars, planted on the 5th April 2007 at Dewageningsdrift

Cultivars	Cutting treatment					Averages for cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	Ct 12 + Re-growth	Ct 14) + Re-growth	Reprod stage	
Witteberg	3.26	2.72	4.12	5.68	2.50	3.65bc
Overberg	2.27	2.51	2.59	3.89	1.86	2.62c
LS 35	3.54	3.66	4.25	4.65	0.78	3.38bc
LS 62	3.67	3.92	4.36	6.38	2.17	4.10ab
Cloc 1	3.18	2.89	3.78	6.60	8.49	4.99a
Average	3.18b	3.14b	3.82b	5.44a	3.16b	
CV %	**17.7 % (Reps)**			**31.9 % (Treatments)**		
LSD						
Interaction	2.16					
Cultivars	1.28					
Cut treat	1.18					

** Ct 8 on the 31st May; Ct 10 on the 14th June; Ct 12 on the 28th June and Ct 14 on the 12th July 2007*

The DM production of an intermediate group (orange in Table 4.2) varied between 3.54 and 5.68 t/ha and did not differ significantly from each other. Third group varied between 0.78 and 3.18 t/ha (yellow in Table 4.2) and also did not differ significantly from each other. If the productions of the three mentioned groups (Table 4.2) are compared, a tendency exists that most cultivars produced the highest when cut for the first time at 14 weeks (Ct 14). This corresponded with the average production for Ct 14, as main effect, which was 5.44 t/ha and significantly higher ($P \leq 0.008$) than the values of the production cutting treatments.

The average production for Cloc 1 triticale and LS 62 stooling rye (cultivar as main effect) did not differ significantly ($P \leq 0.026$) and were 4.99 and 4.10 t/ha, respectively, followed by Witteberg oats with 3.65 t/ha. The average production of Cloc 1 triticale (4.99 t/ha) differed significantly from that of Overberg oats (2.62 t/ha), but not significantly from that of LS 62 rye (4.1 t/ha), Witteberg oats (3.65 t/ha) and LS 35 rye (3.38 t/ha).

To get a better visual impression of the production of the different cultivars in the different cutting treatments, the results are shown in five different bar graphs (Figure 4.1.1 to 4.1.5). The total production of Witteberg oats at the initial cut in 28th June was higher than 3.5 t/ha (Figure 4.1.1) however the highest (5.68 t/ha) were on the 12th July (Ct 14). According to these results, Witteberg oats can be classified as a winter/spring cultivar when planted in April. The 3.5 t/ha (red lines, in Figure 4.1.1 to Figure 4.1.5) is regarded as an acceptable production for a winter crop planted so late in the season. With a production of 3.5 t/ha and an intake of 10 kg DM/LSU/day it is possible to carry 3.5 MLU/ha/100 days.

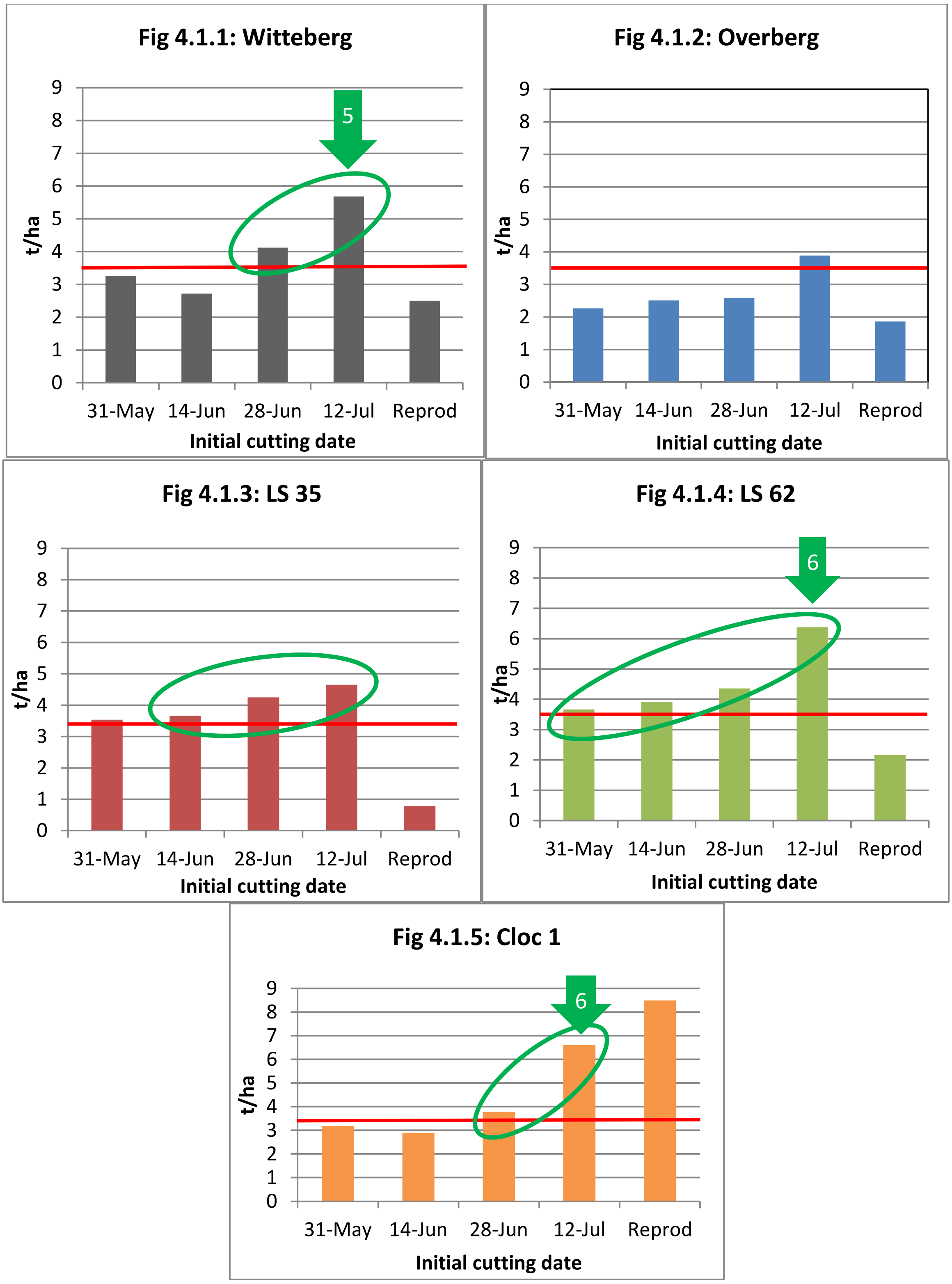

Figure 4.1.1 to 4.1.5: The production pattern of the five winter fodder cultivars planted 5th April 2007, as influenced by initial cutting date.

Overberg oats (Figure 4.1.2) was the lowest producer and can be classified as a Mid-season type, with the highest production of 3.68 t/ha when cut 14 weeks after planting (12th July). LS 35 and LS 62 stooling rye could both be classified as early-winter/spring growing types, when planted on 5 April (Figures 4.1.3 & 4.1.4). Both cultivars produced higher than 3.5 t/ha in all cutting treatment, accept on the reproductive stage. LS 62 stooling rye produced 6.38 t/ha when cut on 12 June.

Cloc 1 triticale was identified as the highest producing cultivar, when planted on the 5th April. According to Figure 4.1.5, this cultivar is a slow starter and can be classified as a late season type. Production is low early in the season, but it did well (6.6 t/ha) when cut on the 12th July (Ct 14), it produced up to 8.49 t/ha when cut at the reproduction stage.

4.1.2.2 Re-growth rate of the five winter fodder crop cultivars.

The cutting dates of the re-growth at the different cutting treatments are given in Table 4.3.

Table 4.3: Cutting dates of re-growth for the 5th April 2007 planting date.

Cutting Treatments	Cutting dates of re-growth		
	Initial Cut	1st re-growth	2nd re-growth
Ct 8	31 May	12 Jun	25 Aug
Ct 10	14 Jun	26 Jul	6 Sept
Ct 12	28 Jun	9 Aug	20 Sept
Ct 14	12 Jul	23 Aug	15 Oct

NB: Re-growth stopped after second re-growth cut.

The re-growth (t/ha DM) obtained on the dates indicated in Table 4.3 were used to fit trend lines (seasonal production) for each cultivar and cutting treatment. These trend lines are shown in Figure 4.2.1 to 4.2.5 for each cultivar

- Re-growth for Witteberg oats.

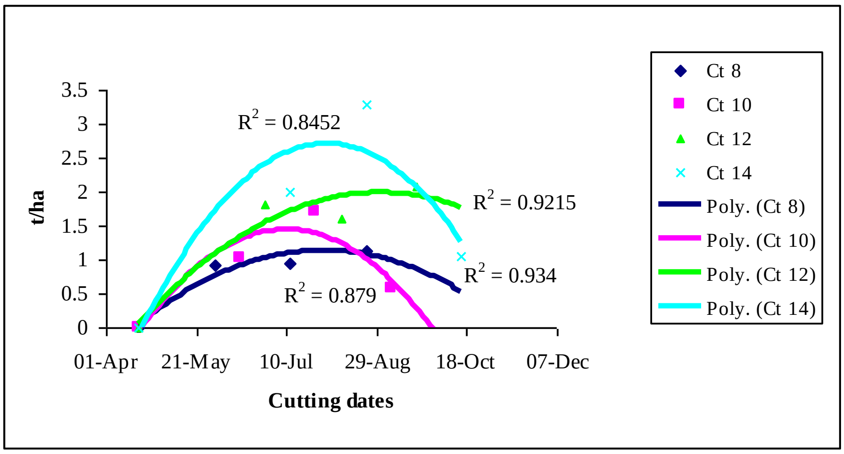

Figure 4.2.1: The influence of cutting treatment on the re-growth of Witteberg oats planted on 05 April 2007.

According to Figure 4.2.1, Witteberg oats cut at (Ct 8) reached an optimum re-growth of 1.1 t/ha in August and after that declined. When Witteberg oats was cut at (C10) it reached an optimum re-growth of 1.3 t/ha during early July and declined after that. Cutting at Ct 12 resulted in an out re-growth of 2.0 t/ha at the end of August and after that it did not decline as much as in the case of the other cutting treatments. Witteberg oats, cut at Ct 14, reached an optimum re-growth of 2.7 t/ha at the end of July and after that it declined.

According to results in Figure 4.2.2, Overberg oats, cut 8 weeks and 12 weeks after planting, reached an optimum production of 1.2 t/ha and 1.3 t/ha, respectively, in Mid-July and late August, after that re-growth declined. Cutting Overberg oats 10 weeks after planting gave an optimum re-growth of 2.1 t/ha early July, and after that it decline. The first cut after 14 weeks resulted in an optimum re-growth of 2.2 t/ha in late August/September. After that it declined, but not as low as in the other cutting treatments.

According to results in Figure 4.2.3, LS 35 stooling rye that was cut initially after 8 weeks; 12 weeks and 14 weeks, resulted in an optimum production of 1.7 t/ha in Mid-July; 1.5 t/ha in August/early September and 2.8 t/ha and in August/early September respectively. After that re-growth did not decline drastically. Cutting LS 35 stooling rye, 10 weeks after planting gave an optimum re-growth of 2.1 t/ha in late June, after that it decline to zero at the end of September.

- Re-growth for Overberg oats.

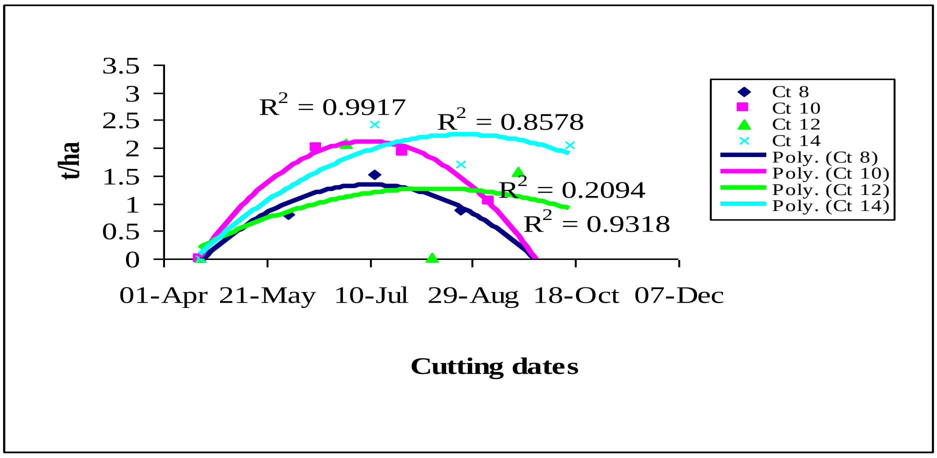

Figure 4.2.2: The influence of cutting treatment on the re-growth of Overberg oats, planted on 05 April 2007.

- Re-growth for LS 35 stooling rye.

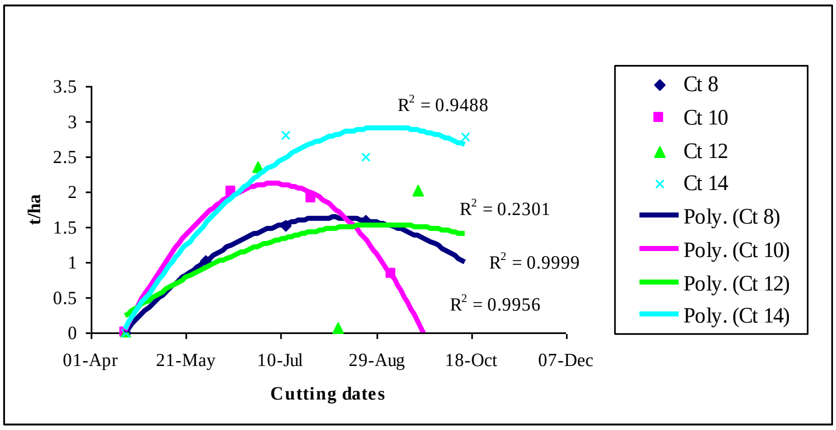

Figure 4.2.3: The influence of cutting treatment on the re-growth of LS 35 stooling rye, planted on 05 April 2007.

- Re-growth for LS 62 stooling rye.

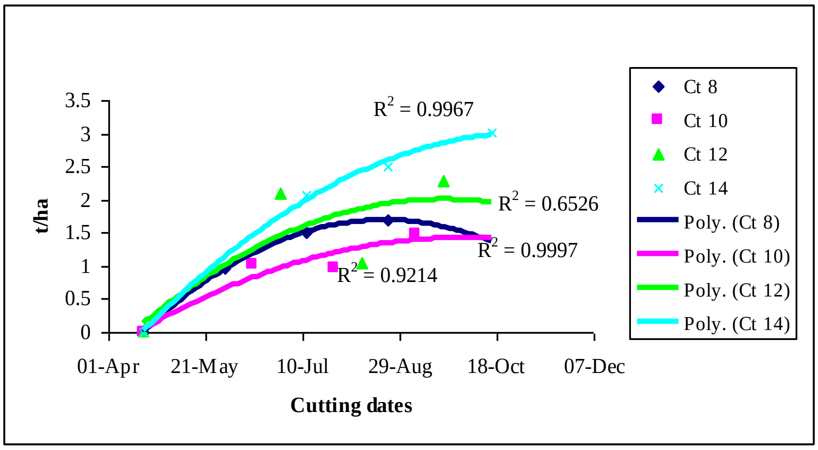

Figure 4.2.4: The influence of cutting treatment on the re-growth of LS 62 stooling rye, planted on 05 April 2007.

According to results in Figure 4.2.4, LS 62 stooling rye did not reach an optimum re-growth (3.5 t/ha) before October. The production trend was the highest (3.0 t/ha in October) at the Ct 14 treatment. This increasing growth trend continued until spring. It is an indication of a late mature, long growing season cultivars. The re-production growth were lower (maximum 1.5 t/ha to 2.0 t/ha) at the other cutting treatments.

➢ Re-growth for Cloc 1 triticale.

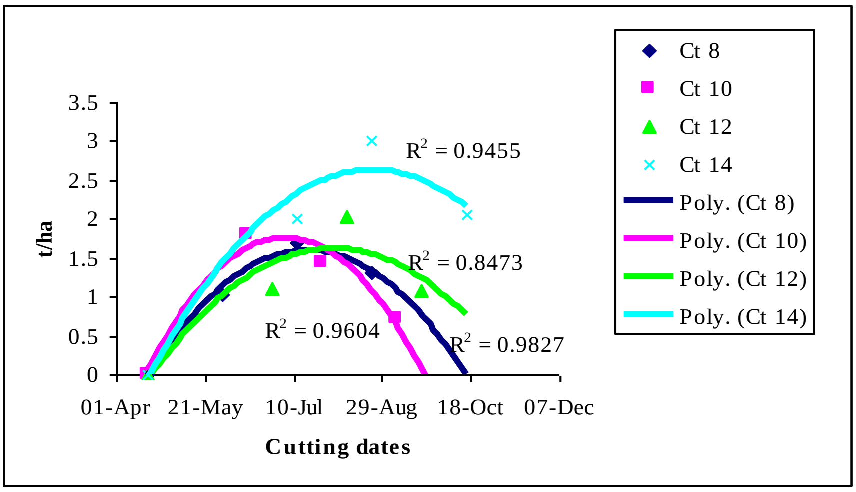

Figure 4.2.5: The influence of cutting treatment on the re-growth of Cloc 1 triticale, planted on 05 April 2007.

According to results in Figure 4.2.5 Cloc, 1 triticale cut 8 weeks and 12 weeks after planting reached an optimum re-growth of 1.4 t/ha (Mid-July) and 1.5 t/ha (Mid-August), respectively. After that, re-growth declined. Cutting Cloc 1 triticale, 14 weeks after planting gave an optimum re-growth of 2.5 t/ha in late August. It could be as high as 3.1 t/ha. After that re-growth declined. The same cultivar cut for the first time 10 weeks after planting reached an optimum production of 1.8 t/ha in early July, with a drastic decline in re-growth towards spring.

4.1.2.3 Summary of the 5th April 2007 planting date results

According to Table 4.2 and Figure 4.1.5 Cloc 1 triticale was the highest producer especially when cut later than 12 July (Ct 14) and in the reproduction stage. Figure 4.2.5 illustrate further that the six weekly re-growth rate of the Ct 14 treatment was the highest and lasted until 18th October. This cultivar can thus be described as a late winter/spring producer.

LS 62 stooling rye was the second highest producer (Table 4.2) and clearly to Figure 4.1.1 produced higher when it was cut on 12th July (Ct 14). This cultivar is also a late winter/spring cultivar. Although earlier initial defoliation (grazing) can be considered, but with at a lower reproduction rate obtained (Figure 4.1.4).

The Witteberg oats growth rate followed the same production trend as Cloc 1 triticale and LS 62 stooling rye (late winter/spring production), when defoliated on the 28th June (Ct 12). The re-growth rate was lower but the production period continued longer. It can be grazed later the than 18th October.

LS 35 stooling rye produced on average (all cutting treatment), 3.38 t/ha (Table 4.2). It is the only cultivar that produced above 3.0 t/ha of re-growth. This cultivar can thus be described as an early winter/spring producer.

Overberg oats was the lowest producer (2.62 t/ha on average). A combination of Overberg oats planted in April and defoliation at 10 weeks and 14 weeks can supply fodder (at a relative low production rate) from May to October (full season).

A final option to produce maximum fodder for the longest period in winter will be to plant and utilize the following cultivars:

1. Overberg oats and/or LS 35 stooling rye to be utilized from 10 weeks after planting.
2. Witteberg oats and/or LS 35 stooling rye to be utilized from 14 weeks after planting onwards for winter fodder (July to September).
3. Cloc1 triticale and/or LS 62 stooling rye to be utilized from 14 weeks onwards for late winter/spring fodder (September to October).

4.1.3 Results obtained from the 4th May 2007 planting date.

4.1.3.1 Dry matter production (DM production).

Table 4.3 represents the DM production of plots that were planted on the 4th May 2007 The statistical analysis of the data is given in Appendix A.2. The different cutting dates in the different treatment were Ct 8 on 28th June; Ct 10 on 12th July; Ct 12 on 26th July and Ct 14 on 9th August (Table 4.3).

According to Appendix A.2, the interaction between cultivars and cutting treatments did not influence the DM yield significantly ($P \leq 0.194$) as main effects cultivars did not influence DM production significantly ($P \leq 0.148$), while cutting treatment had a significant influence ($P \leq 0.022$).

According to Table 4.4, the highest DM production was measured with LS 62 stooling rye (8.18 t/ha at Ct14); LS 62 stooling rye (7.55 t/ha at Ct 12); Witteberg oats (7.3 t/ha at Ct14); Cloc1 triticale (7.02 t/ha at Ct 10) and LS 62 (6.97 t/ha at Ct 10).

Table 4.4: The influence of cutting treatments on the DM production of different winter pasture cultivars, planted the 4th May 2007 at Dewageningsdrift.

Cultivars	Cutting treatment *					Average for Cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	Ct 12 + Re-growth	Ct 14 + Re-growth	Reprod stage	
Witteberg	**3.80**	**3.66**	**3.76**	**7.30**	**1.72**	**4.05ab**
Overberg	**2.8**	**3.86**	**4.93**	**5.44**	**2.32**	**3.87b**
LS 35	**6.14**	**3.77**	**5.01**	**5.91**	**3.27**	**4.82ab**
LS 62	**3.64**	**6.97**	**7.55**	**8.18**	**2.14**	**5.70ab**
Cloc 1	**4.85**	**7.02**	**4.76**	**6.66**	**6.84**	**6.02a**
Averages	**4.25bc**	**5.06ab**	**5.20ab**	**6.69a**	**3.26c**	
CV %	(9.8 %) Reps			(41.2 %) Treatments		
LSD						
Interaction	3.51					
Cultivars	2.07					
Cut treat	1.79					

** Ct 8 on the 28th June; Ct 10 on the 12th July; Ct 12 on the 26th July and Ct 14 on the 9th August 2007*

Production did not differ significantly from each other (red in table). The production of an intermediate production group (orange in table) varied between 4.76 and 6.84 t/ha and did not differ significantly from each other. The lowest production values varies between 1.72 t/ha and 3.86t/ha and did not differ significantly from each other (yellow in table).

If the production values of the three mentioned groups are compared (Fischer's protected LSD = 3.51), a tendency existed that most cultivars produced the best when cut for the first time at 14 weeks (Ct 14). This corresponds with the average production for Ct 14, as main effect, which were 6.69 t/ha and significantly higher ($P \leq 0.022$) than the average of Ct 8 and the reproductive stage. The lowest average production was measured at the reproduction stage (3.26 t/ha) which was not significantly lower than that of Ct 8 (4.25 t/ha), but significantly lower than that of the Ct 10, Ct 12 and Ct 14 treatment.

The average production for Cloc 1 triticale (cultivar as main effect) was 6.02 t/ha (Table 4.3) which differed significantly ($P \leq 0.148$) from of Overberg oats (3.87 t/ha), but not from of LS 62 stooling rye (5.7 t/ha); LS 35 stooling rye (4.82 t/ha) and Witteberg oats (4.05 t/ha).

In Figures 4.3.1 to 4.3.5 the influence of the initial cutting date on total DM production is illustrated more visually.

According to Figure 4.2.1, the total DM production of Witteberg oats that was planted in early May was approximately 3.5 t/ha when cut at the Ct 8, Ct 10 and Ct 12 treatments.

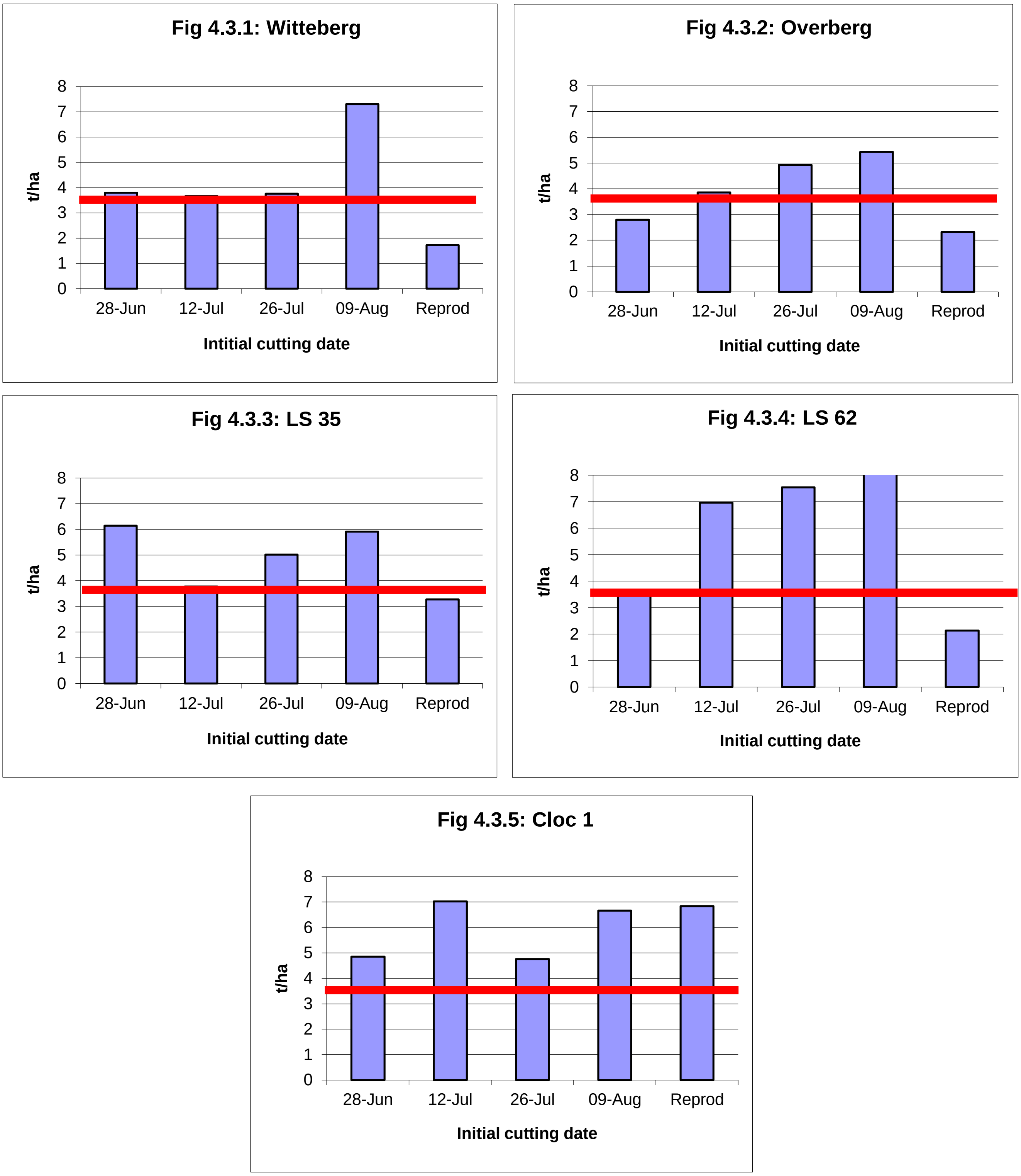

Figure 4.3.1 to 4.3.5: The production pattern of the five winter fodder cultivars planted the 4th May 2007 as influenced by initial cutting date.

However the highest production was reached (7.50 t/ha) when cut on the 9th August (Ct 14). Left undisturbed until the reproduction stage, production was lower than 2 t/ha. For this reason Witteberg oats could be classified as a late winter/spring cultivar if planted in May.

[The 3.5 t/ha (red line, in Figure 4.3.1 to Figure 4.3.5) is regarded as an acceptable production for a winter crop planted so late in the season].

Overberg oats (Figure 4.3.2) could be classified as a mid-season cultivar with production higher than 3.5 t/ha when cut on 12 July and 26 July, with the highest production of 5.23 t/ha when cut on the 9th August (Ct 14). LS 35 stooling rye (Figure 4.3.3) can be classified as mid-season growing cultivars when planted on 4 May. LS 62 stooling rye (Figure 4.3.4) produced 3.5 t/ha when cut on 28 June but as high as 7.0 to 8.18 t/ha when cut later in the season (late winter to spring growing type).

Cloc 1 triticale (Figure 4.3.5) produced from 28 June until the reproductive stage. It produced higher than 4.5 t/ha and can be classified as a full winter/spring growing type.

4.1.3.2 Re-growth rate of the five winter fodder crop cultivars planted the 4th May 2007.

The exact cutting dates of the re-growth at the different cutting treatments are given in Table 4.5.

Table 4.5: Cutting dates of re-growth for the 4th May 2007 planting date

Cutting Treatments	Cutting dates of re-growth		
	Initial Cut	1st re-growth	2nd re-growth
Ct 8	28 Jun	9 Aug	20 Sept
Ct 10	12 Jul	23 Aug	4 Oct
Ct 12	26 Jul	6 Sept	18 Oct
Ct 14	9 Aug	20 Sept	1 Nov

NB: Re-growth stopped after second re-growth cut.

The re-growth obtained on the dates indicated in Table 4.5 was used to fit trend lines (seasonal production) for each cultivar and cutting treatment. These trend lines are shown in Figure 4.4.1 to 4.4.5 for each cultivar.

According to results in Figure 4.4.1, Witteberg oats, that was cut 14 weeks after planting, reached an optimum re-growth 3.8 t/ha (even as high as 5.3 t/ha) in August/early September. After that it declined. When Witteberg oats was cut 8 weeks after planting it reached an optimum DM production of 1.5 t/ha in Mid-July. Re-growth declined after that. The first cut 10 and 12 weeks after planting, resulted in the same trend as the first cut after 8 weeks, which reached an optimum DM production of 1.6 t/ha and 1.9 t/ha in Mid-July/August, respectively.

➢ Re-growth for Witteberg oats.

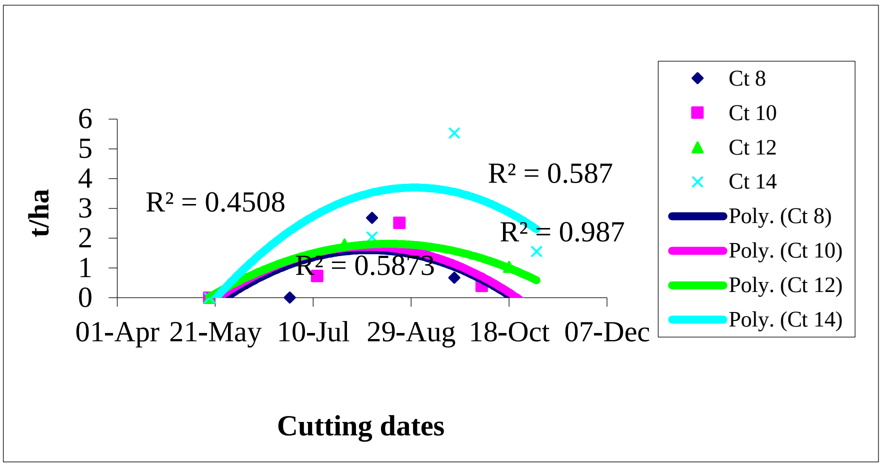

Figure 4.4.1: The influence of cutting treatments on the re-growth of Witteberg oats, planted on 4th May 2007.

➢ Re-growth for Overberg oats.

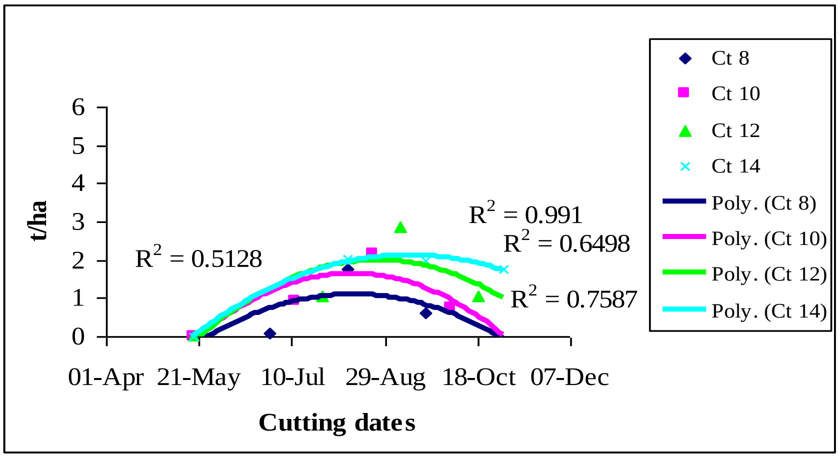

Figure 4.4.2: The influence of cutting treatments on the re-growth of Overberg oats, planted on 4th May 2007.

According to results in Figure 4.4.2 Overberg oats, cut 12 weeks and 14 weeks after planting reached an optimum re-growth production of 2.1 t/ha and 2.3 t/ha respectively in August and early October, respectively. After that re-growth declined. Cutting Overberg oats 8 weeks after planting gave an optimum re-growth of 1.0 t/ha in Mid-July. After that re-growth declined. The first cut 10 weeks after planting resulted in an optimum DM production of 1.5 t/ha in August. After that re-growth declined, but not as low as in the Ct 8 treatment.

➢ Re-growth for LS 35 stooling rye.

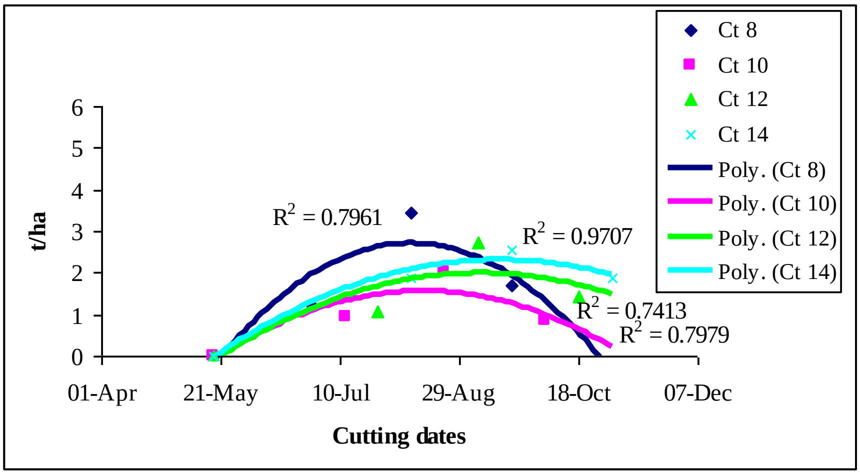

Figure 4.4.3: The influence of cutting treatments on the re-growth of LS 35 stooling rye, planted on 4th May 2007.

According to results in Figure 4.4.3, LS 35 stooling rye that was cut initially 10 weeks; 12 weeks and 14 weeks after planting, resulted in optimum DM productions of 1.5 t/ha end-July; 1.8 t/ha and 2.1 t/ha, respectively, in Sept for Ct12 and Ct14. Re-growth not decline drastically. Cutting LS 35 stooling rye, 8 weeks after planting gave an optimum DM production of 2.5 t/ha in early August. After that, re-growth declined to zero by Mid-October.

- Re-growth for LS 62 stooling rye.

According to results in Figure 4.4.4 LS 62 stooling rye, that was cut 8 weeks and 10 weeks after planting resulted in an optimum DM production of 2.0 t/ha and 3.0 t/ha respectively, in the period July and August. Re-growth after that declined to zero by early and Mid-October. Cutting LS 62 stooling rye, 12 weeks after planting gave an optimum DM production of 3.3 t/ha in late August. Re-growth did not decline drastically after that. When cut first 14 weeks after planting, LS 62 stooling rye did not reach an optimum DM production during late October, which was 3.5 t/ha.

According to results in Figure 4.4.5, Cloc 1 triticale defoliated 10 weeks after planting gave an optimum DM production of 3.0 t/ha in late August; but it can even be as high as 5.1 t/ha. After that re-growth declined. The first cut after 8 weeks resulted in an optimum re-growth production of 2.1 t/ha July, but could even be as high as 3.5 t/ha. Re-growth declined after that. Initial defoliation at 14 weeks delayed the optimum re-growth till October. Cutting Cloc 1 triticale 12 weeks after planting produced an optimum DM production of 1.9 t/ha in August/ September. After that re-growth declined.

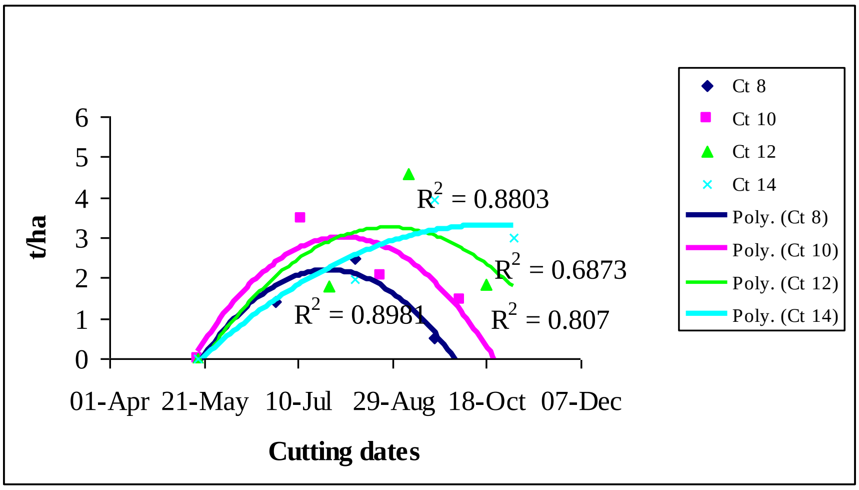

Figure 4.4.4: The influence of cutting treatments on the re-growth of LS 62 stooling rye, planted on 4th May 2007.

- Re-growth for Cloc 1 triticale.

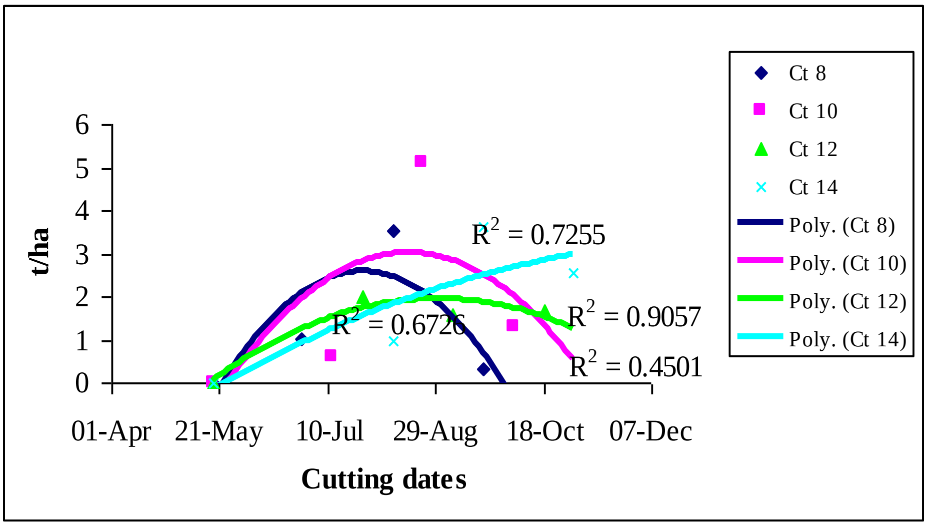

Figure 4.4.5: The influence of cutting treatments on the re-growth of Cloc 1 triticale, planted on 4th May 2007.

Cloc 1 triticale was, on average the highest producer (Table 4.4) and can be a Mid-winter producer when cut in July (Ct 10). However, it can also be a late winter/spring producer when cut in August (Ct 14). According to Table 4.3 and Figure 4.4.4, LS 62 stooling rye was on average, the highest producer, especially when cut between 12 July and 9 August. Figure 4.3.4 illustrated that the six weekly re-growth rate of the Ct 14 treatment (9 August) was the highest and lasted until October. This cultivar can thus be described as late winter/spring cultivar.

4.1.3.3 Summary of the 4th May 2007 planting date results

Witteberg Oats was the second highest producer (Table 4.4) it produced higher when it was cut on the 9th August (Figure 4.3.1). Figure 4.4.1 confirmed that the late initial cut (Ct 14 on the 9th August) also had an effect on the six weekly re-growths (peaked in late August). This cultivar is also a late winter/spring cultivars, although earlier initial defoliation (or grazing) can be considered, but at a lower reproduction rate (Figure 4.3.1).

LS 35 stooling rye produce on average over all cutting treatments 4.82 t/ha (Table 4.4). LS 35 and Cloc1 triticale the only two cultivars that produced 3.0 t/ha over all cutting treatments (Figure 4.3.3 and 4.3.5). According to the regrowth production trends, combination of the Ct 8 and Ct 14 defoliation treatments can supply fodder from early July to end October.

Overberg oats was the lowest producer (3.87 t/ha) on average (Table 4.4). Overberg oats (planted May) can be cut in August (Ct 14) to supply fodder (at a low production rate) from end August to October.

A final option to produce maximum fodder for the longest period in winter will be to plant and utilize the following cultivars:

1. Cloc1 triticale and/or LS 62 stooling rye were the highest producers and can be utilize at from 14 weeks after planting onwards for late winter/spring fodder (September to October). However they can also be utilized from 12 July (Ct 10) onwards for fodder planning.
2. Witteberg oats can be utilized from 14 weeks after planting, onwards for fodder in August to September.
3. LS 35 stooling rye can be utilized from 12 and 14 weeks after planting onwards for fodder in July to September.

4.1.4 Results obtained from the 6th June 2007 planting date

4.1.4.1 Dry matter production (DM production).

Table 4.6 represents the DM production of plots that were planted on the 6th June 2007. The statistical analysis of the data is given in Appendix A.3. The different cutting dates for the different treatments were Ct 8 on the 1st August; Ct 10 on the 15th August; Ct 12 on the 29th August and Ct 14 on the 12th September (Table 4.4).

According to Appendix A3, there was no significant (P≤0.21) interaction between cultivars and cutting treatments, in terms of DM production. However if the results in Table 4.4 are compared (Fisher's protected LSD = 2.24), a production trend was recognized. Cultivars and cutting treatments as main effects both influenced DM production significantly (P≤0.001 respectively).

Table 4.6: The influence of cutting treatments on the DM production of different winter pasture cultivars, planted the 6th June 2007 at Dewageningsdrift.

Cultivars	Cutting treatment*				Averages for cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	Ct 12 + Re-growth	Ct 14 + Re-growth	
Witteberg	**3.20**	**2.35**	**2.61**	**1.11**	**2.32a**
Overberg	**2.74**	**3.48**	**1.10**	**0.60**	**2.20a**
LS 35	**3.73**	**7.22**	**2.55**	**0.80**	**3.57a**
LS 62	**4.25**	**5.06**	**2.17**	**0.82**	**3.08a**
Cloc 1	**2.58**	**4.64**	**1.89**	**0.92**	**2.51a**
Average	**3.30b**	**4.55a**	**2.06c0tt4c**	**0.85d**	
CV %	6.3 % (Reps)		49.3 % (Treatments)		
LSD					
Interaction	2.24				
Cultivars	1.42				
Cut treat	0.99				

** Ct 8 on the 1st August; Ct 10 on the 15th August; Ct 12 on the 29th August and Ct 14 on the 12th September 2007*

According to Table 4.6, LS 35 stooling rye had the highest DM production (7.22 t/ha) at the 10 weeks (Ct 10) which did not differ significantly from that of LS 62 stooling rye at Ct 10 (red in table). The production of LS 35 stooling rye (Ct 10) and LS 62 stooling rye (Ct 8) did not differ significantly from each other (orange in table). The production of the second group (yellow in table) varied between 3.20 t/ha and 3.73 t/ha. A third production group occurred, which varied between 1.1 t/ha and 2.74 t/ha (green in table). The lowest production group (white) occurred mainly at the Ct 14 cutting treatment with less than 1.11 t/ha.

The interaction corresponds with the average production for Ct 10, as main effect, which were 4.55 t/ha and significantly higher (P≤0.001) than the values of the other cutting treatments. The average production for LS 35 stooling rye and LS 62 stooling rye (cultivar as main effect) was 3.57 and 3.08 t/ha, respectively, which did not differ significantly (P≤0.233) from the rest (Cloc 1 triticale 2.51 t/ha, Witteberg oats 2.32 t/ha and Overberg oats 2.20 t/ha).

The production trend is also given in Figure 4.5 where the production patterns, as influenced by initial cutting date, are illustrated. As indicated in Table 4.6, Witteberg oats and Overberg oats were the lowest producers. According to Figure 4.5.1 and 4.5.2, these two cultivars produced the highest (± 3.5 t/ha) when cut on 1st August (Ct 8) and 15th August (Ct 12), respectively. The 3.5 t/ha (red line, Figure 4.5.1 to 4.5.5) is regarded as a relatively good production for a winter crop planted late in the season.

LS 35 stooling rye and LS 62 stooling rye both produced higher than 3.5 t/ha, when planted on the 6th June and cut on 1st August and 15th August (Figures 4.5.3 & 4.5.4). LS 35 stooling rye produced 7.22 t/ha when cut on the 15th August and LS 62 stooling rye produced 5.06 t/ha when cut on the 15th August (Ct 10). Cloc 1 triticale produce low early in the season, but it did better (4.64 t/ha) when cut on the 15th August (Ct 10).

4.1.4.2 Re-growth tempo of the five winter fodder crop cultivars.

The cutting dates of the re-growth at the different cutting treatments are given in Table 4.7.

Table 4.7: Cutting dates of re-growth for 6th June 2007 planting date

Cutting Treatments	Cutting dates of re-growth	
	Initial Cut	1st re-growth
Ct 8	1 Aug	29 Aug
Ct 10	15 Aug	12 Sept
Ct 12	29 Aug	26 Sept

NB: Re-growth stopped after first re-growth cut.

The re-growth (t/ha DM) obtained on the dates indicated in Table 4.7 were used to fit trend lines (seasonal production) for each cultivar and each cutting treatment. These trend lines are shown in Figure 4.6.1 to 4.6.5.

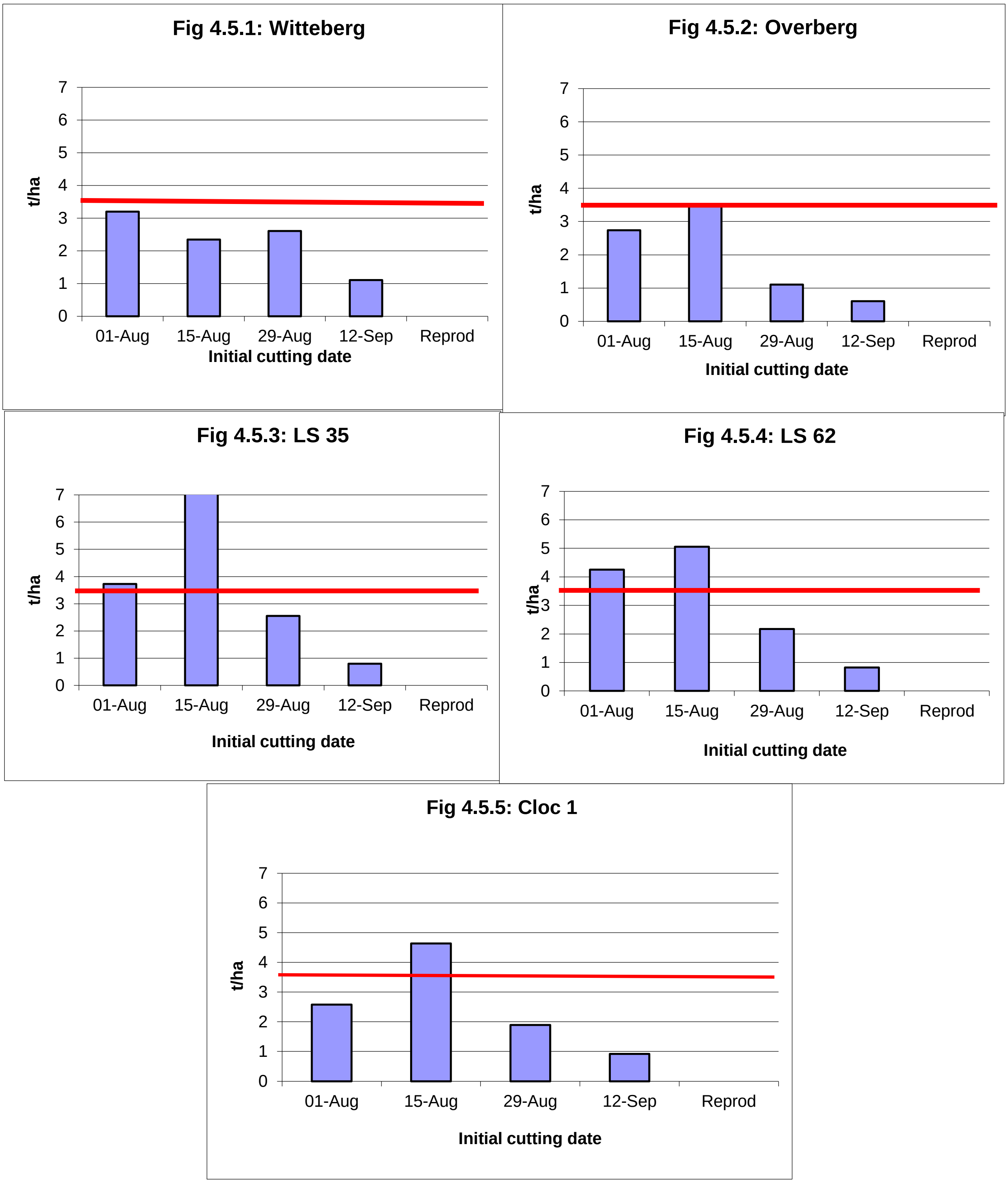

Figure 4.5.1 to 4.5.5: The production pattern of five winter fodder cultivars planted 6 June 2007, as influenced by initial cutting date.

➢ Re-growth for Witteberg oats.

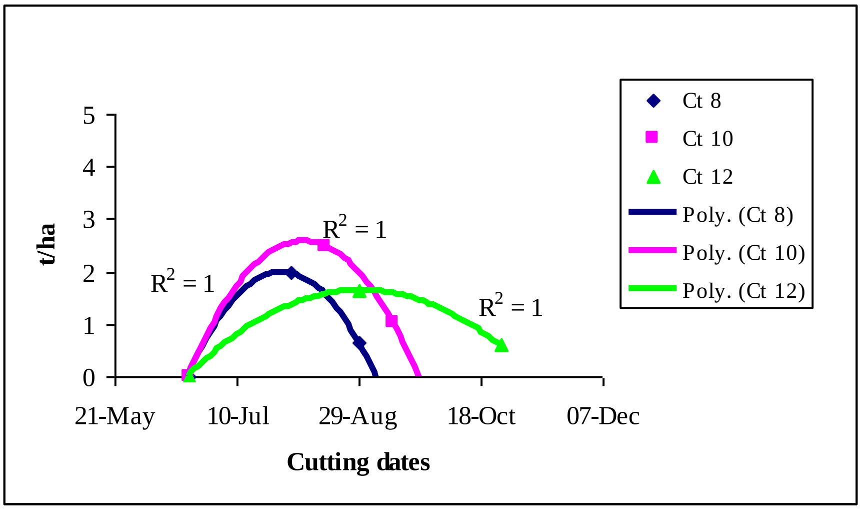

Figure 4.6.1: The influence of cutting treatments on growth of Witteberg oat, planted on 6th June 2007.

According to Figure 4.6.1, Witteberg oats, cut 12 weeks after planting reached an optimum production of 1.9 t/ha at the end August. After that re-growth declined. Cutting after 8 and 10 weeks resulted in peak productions of 2.4 t/ha and 2.9 t/ha, and after that re-growth declined.

According Figure 4.6.2, Overberg oats, cut initially12 weeks after planting (Ct 12) reached an optimum production of 1.2 t/ha in September. After that re-growth declined. The initial cut after 8 and 10 weeks, resulted in a production peak of 3.0 t/ha and 1.8 t/ha respectively, and after that their re-growth declined.

➢ Re-growth for Overberg oats.

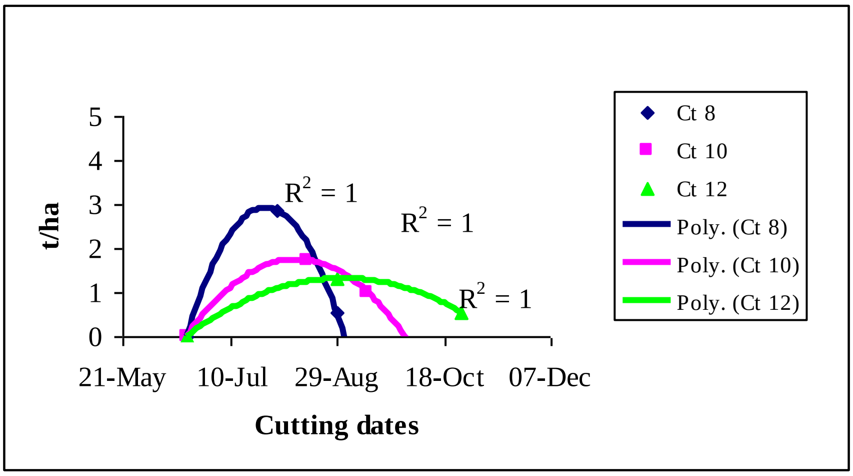

Figure 4.6.2: The influence of cutting treatments on growth of Overberg oat, planted on 6th June 2007.

➢ Re-growth for LS 35 stooling rye.

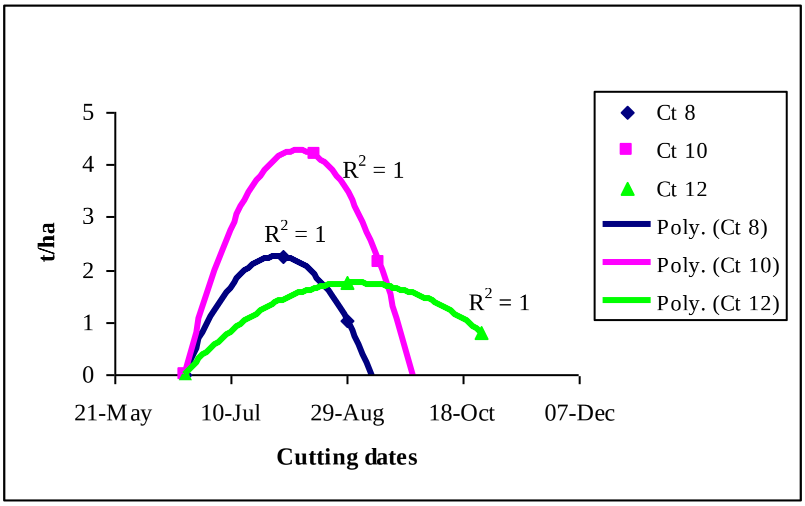

Figure 4.6.3: The influence of cutting treatments on growth of LS 35 stooling rye, planted on 6th June 2007.

According to Figure 4.6.3, LS 35 stooling rye, cut 12 weeks after planting (Ct 12), reached an optimum production of 1.9 t/ha at the end of August. After that re-growth declined. The initial cut after 8 and 10 weeks resulted in a production peaks of 2.2 t/ha (end July) and 4.4 t/ha (Mid-August). After that re-growth declined.

According to Figure 4.6.4, LS 62 stooling rye, cut 12 weeks after planting (Ct 12), reached an optimum production of 1.5 t/ha at the end of August. After that re-growth declined. The initial cut after 8 and 10 weeks resulted in a production peak of 2.9 t/ha and 3.2 t/ha in Mid-July and Mid-August. After that the re-growth declined.

➢ Re-growth for LS 62 stooling rye.

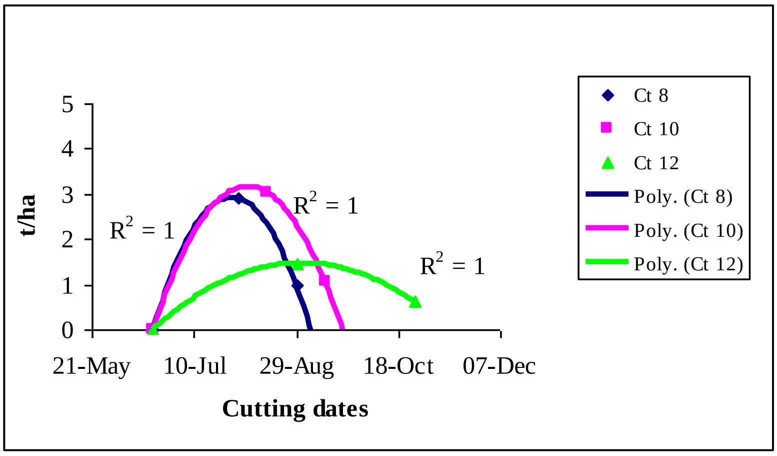

Figure 4.6.4: The influence of cutting treatments on growth of LS 62 stooling rye, planted on 6th June 2007.

According to Figure 4.6.5, Cloc 1 triticale, cut 12 weeks after planting (Ct 12), reached an optimum production of 1.3 t/ha at the end of August. After that re-growth declined. The cut after 8 and 10 weeks resulted in a DM production peak of 2.4 t/ha (late July) and 2.6 t/ha (late August), after which the re-growth declined.

➢ Re-growth for Cloc 1 triticale.

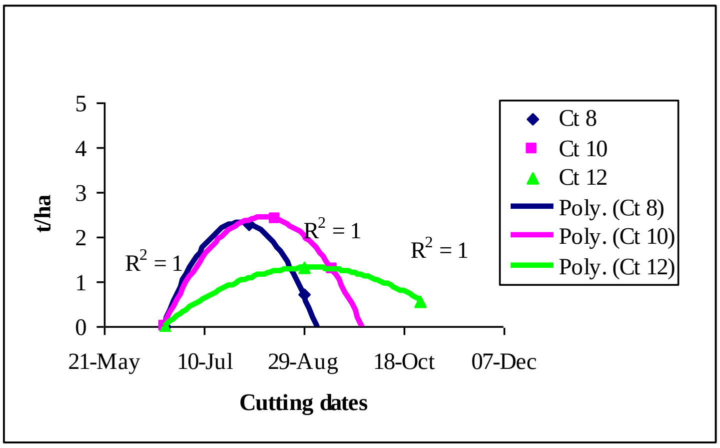

Figure 4.6.5: The influence of cutting treatments on growth of Cloc 1 Triticale, planted on 6th June 2007.

4.1.4.3 Summary of the 6th June 2007 planting date results

According to Table 4.6 and Figure 4.5.3, LS 35 stooling rye was the highest producer when cut on the 15th August (Ct 10). Figure 4.6.3 further illustrated that the six weekly re-growth rate of the Ct 10 treatment peaked the highest in Mid-August. This cultivar, when planted in June, and cut on the 15th August can thus be described as a late winter producer. When cut 29th August it produced lower but continued to late as Aug/Sept.

LS 62 Stooling rye was the second highest producer (Table 4.6.) and produced the highest when it was cut on the 15th August (Fig 4.5.4). Figure 4.6.4 further confirmed that an cut on the 15th August (Ct 10) also had a positive effect on the six weekly re-growths, which peaked (3.2 t/ha) in mid-August.

Cloc 1 triticale followed the same production trend as LS 62 stooling rye. However, it produced lower (15th August, Fig 4.4.5) although Overberg and Witteberg oats were, on average, the lowest producers, the re-growth of these cultivars played an important role with productions of ± 3.0 t/ha in late July and early August.

To produce maximum fodder for the longest period in winter, with late (June) establishment, an option will be to plant and utilize the following cultivars.

1. Overberg oats (Ct 8) and Witteberg oats (Ct 10) oats for late July and early August utilization.
2. LS 62 and LS 35 stooling rye (both Ct 10) for Mid-August utilization.
3. Although low in production, LS 35 stooling rye (Ct 12) can produce fodder at the end Sept/Oct.

4.1.5 Results obtained from the 20th July 2007 planting date.

4.1.5.1 Total dry matter production (DM production).

Table 4.8 represents the DM production of plots that were planted on the 20 July 2007. The statistical analysis of the data is given in Appendix A.4. The different cutting dates of the different treatment were Ct 8 on the 31st August; Ct 10 on the 14th September; Ct 12 on the 28th September and Ct 14 on the 12th October.

According to Appendix A.4, a highly significant ($P \leq 0.001$) interaction occurred between DM yields of cultivars and cutting treatments. The DM yields of cultivars and cutting treatments (as main effects) both differed significantly ($P \leq 0.038$ and $P \leq 0.001$, respectively).

Table 4.8: The influence of cutting treatments on the DM production of different winter pasture cultivars, planted 6th July 2007 at Dewageningsdrift.

Cultivars	Cutting treatment					Average for cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	Ct 12 + Re-growth	Ct 14 + Re-growth	Reprod Stage	
Witteberg	0.81	3.69	0.69	7.50	3.84	3.31ab
Overberg	1.06	4.11	1.10	1.21	5.73	2.64b
LS 35	1.0	4.51	0.79	1.46	4.11	2.37b
LS 62	1.00	5.47	0.88	8.56	3.22	3.86a
Cloc 1	1.19	3.64	1.08	2.86	3.76	2.42b
Average Cut treatments	0.96c	4.28ab	0.91c	4.32a	4.13ab	
CV %	20 % (Reps)			31 % (Treatments)		
LSD						
Interaction	2.03					
Cultivars	1.02					
Cut treat	1.55					

** Ct 8 on the 31stAugust; Ct 10 on the 14th September; Ct 12 on the 28th September and Ct 14 on the 12th October 2007*

According to Table 4.8, LS 62 had the highest DM production (8.56 t/ha) at the Ct 14, which did not differ significantly from that of Witteberg oats at Ct 14 (7.50 t/ha) (red in table 4.8). Overberg (5.73 t/ha), in the reproductive stage, and LS 62 stooling rye (5.47 t/ha) at Ct 10 formed at second production group (orange in table). Witteberg oats (Ct 10 and reproductive stage), Overberg oats (Ct 10), LS 35 stooling rye (Ct 10 and reproductive stage), LS 62 stooling rye and Cloc 1 triticale (Ct 10, Ct 14 and reproductive stage) formed a third production group (yellow in table) which varied between 3.22 and 4.51 t/ha.

The production of a fourth group (green in table) varied between 1.1 t/ha and 1.46 t/ha. The lowest productions were 0.69 t/ha and 0.79 t/ha. If the production of the four highest production groups are compared, (Fisher protected LSD = 2.03) a tendency existed that most cultivars produced the highest when cut for the first time at 14 weeks (Ct 14).This trend was also illustrated in the 4.32 t/ha obtained at Ct 14 as main treatment. However, this result does not differ significantly ($P \leq 0.001$) from results obtained from Ct 10 (4.28 t/ha) and the reproductive stage (4.13 t/ha).

The influence of initial cutting date on total DM production (Table 4.8) is also shown in Figures 4.7.1 to 4.7.5 in a more visual format.

The average production for LS 62 stooling rye and Witteberg oats (cultivar as main effect) did not differ significantly ($P \leq 0.038$) and were 3.86 and 3.31 t/ha, respectively. The production of LS 62 stooling rye was significantly ($P \leq 0.038$) higher than that of Overberg oats, Cloc 1 triticale and LS 35 stooling rye.

According to Figures 4.7.1 to 4.7.5 there was a general trend that all cultivars produced low when cut 31 on August (Ct 8) and 28 September (Ct 12). According to Table 4.8, Witteberg oats act as a mid to late season type when planted in early July. The total production was higher than 3.5 t/ha (Figure 4.7.1) when cut on the 14th September (Ct 10). However the highest production was reached (7.50 t/ha) when cut initially on the 12th October (Ct 14). [The 1.0 t/ha (red line, in Figure 4.7.1) is regarded as a relative good production for a winter crop planted so late in the season].

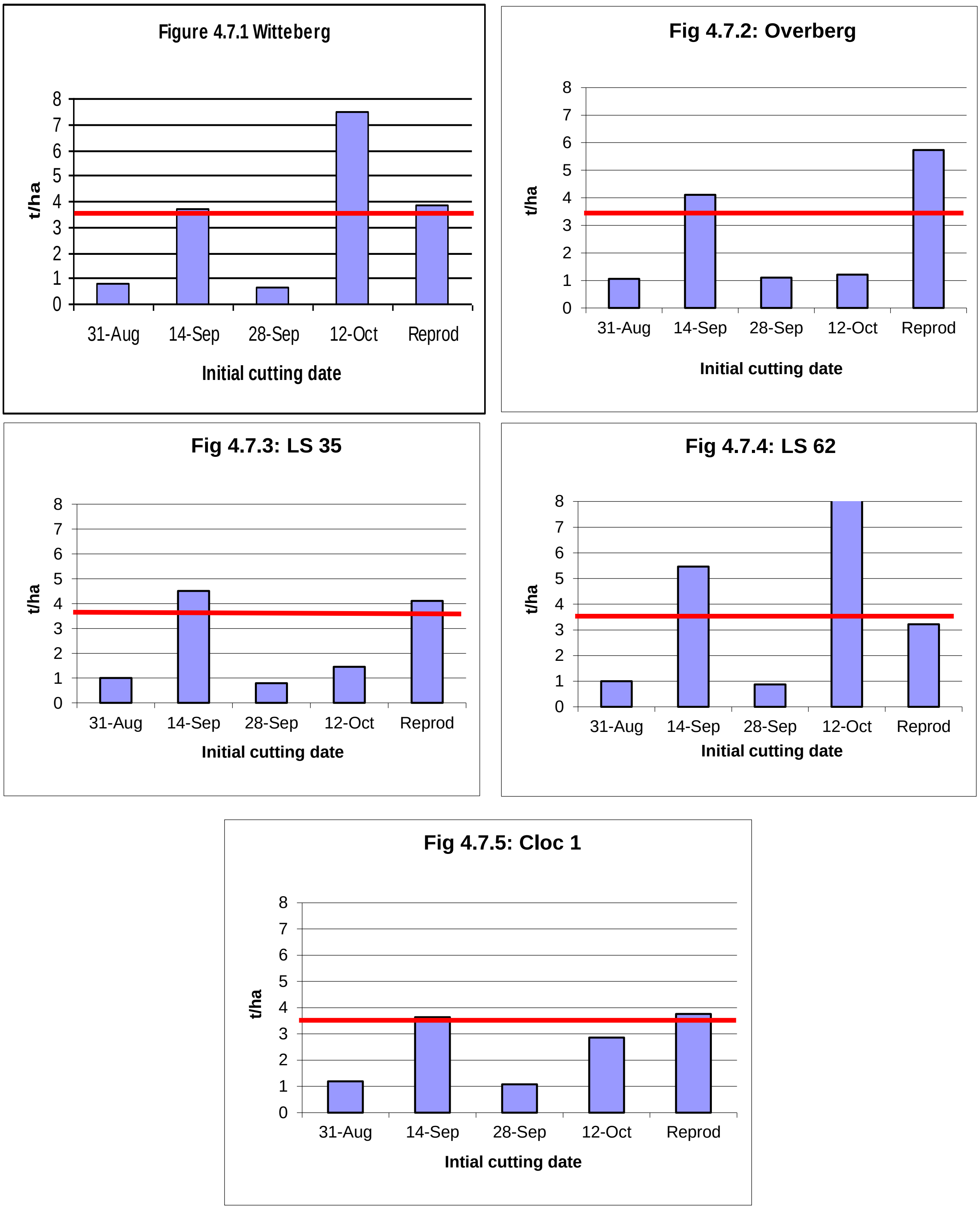

Figure 4.7.1 to 4.7.5: The production pattern of the five winter fodder cultivars planted 6th July 2007, as influenced by initial cutting date.

Overberg oats (Figure 4.7.2) was the lowest producer and can be classified as a mid-season type, with the highest production of 4.0 t/ha when cut initially on the 14th September (Ct 10). Although, when left to grow undisturbed, it produced 5.8 t/ha in the reproductive stage.

LS 35 and LS 62 stooling rye both produced relatively high (4.5 t/ha and 5.5 t/ha, respectively) and earlier (in September) than the rest. LS 62 stooling rye reacted as a late producer with more than 8 t/ha in October (late planting date).

The production of Cloc 1 triticale was low early in the season, but it did relatively well (3.5 t/ha) when cut on the 14th September (Ct 10) and in the reproductive stage. The results in Figure 4.7.5 might be an indication that Cloc 1 triticale should not be planted in July.

4.1.5.2 Re-growth tempo of the five winter fodder crop cultivars planted in July.

The exact cutting dates of the re-growth at the different cutting treatments are given in Table 4.9.

Table 4.9: Cutting dates of re-growth for the 6th July 2007 planting date.

Cutting Treatments	Cutting dates of re-growths	
	Initial Cut	1st re-growth
Ct 8	31 Aug	12 Oct
Ct 10	14 Sept	26 Oct
Ct 12	28 Sept	09 Nov

NB: Re-growth stopped after first re-growth cut.

The re-growth (t/ha DM) obtained on these dates, were used to fit trend lines (seasonal re-growth) for each cultivars and cutting treatment. These trend lines are shown in Figure 4.8.1 to 4.8.5 for each cultivar.

➢ Re-growth for Witteberg oats.

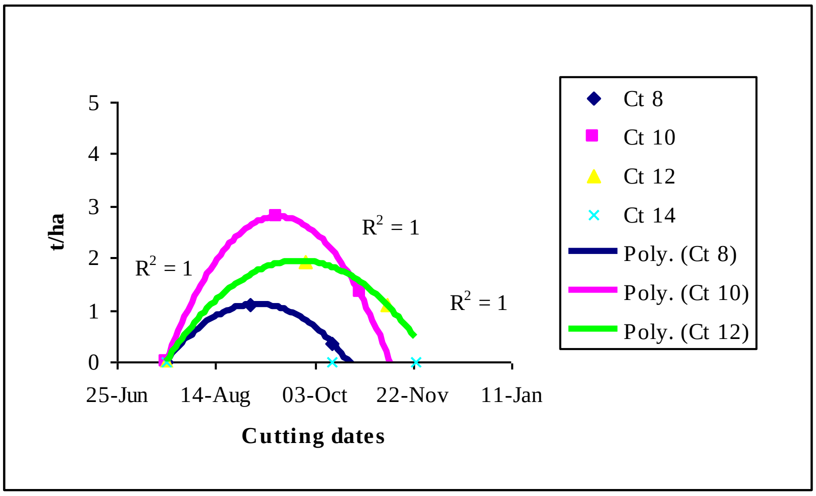

Figure 4.8.1: The influence of cutting treatments on growth of Witteberg oats, planted on 6th July 2007.

According to Figure 4.8.1, Witteberg oats, cut 10 weeks after planting (Ct 10), reached an optimum production of 2.9 t/ha in early September and after that re-growth declined. If cut after 8 and 12 weeks, production peaked (1.1 t/ha and 2.2 t/ha) in late August and late September, respectively, after that re-growth declined.

- Re-growth for Overberg oats.

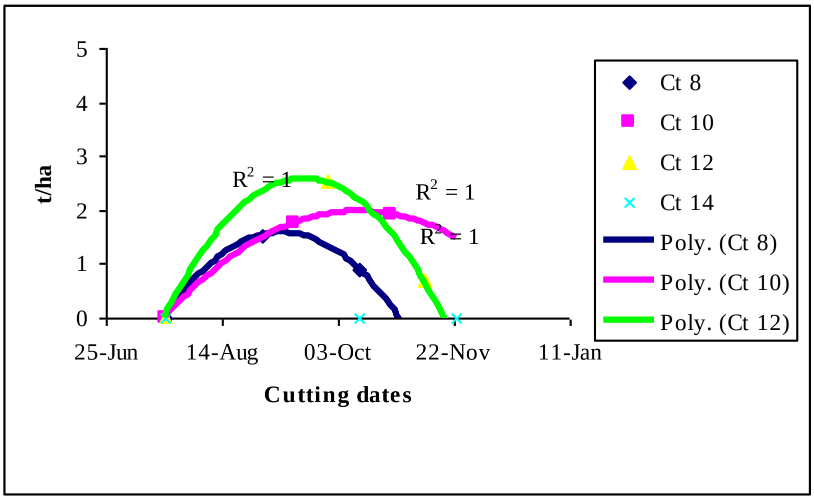

Figure 4.8.2: The influence of cutting treatments on growth of Overberg oats, planted on 6th July 2007.

According Figure 4.8.2, Overberg oats, cut 8 weeks and 10 weeks after planting (Ct 8 and Ct 10), reached an optimum production of 1.6 t/ha and 1.9 t/ha, respectively, late August and Mid-October and after that re-growth declined. The cut after 12 weeks resulted in a production peak of 2.9 t/ha in early September, where after re-growth declined

- Re-growth for LS 35 stooling rye.

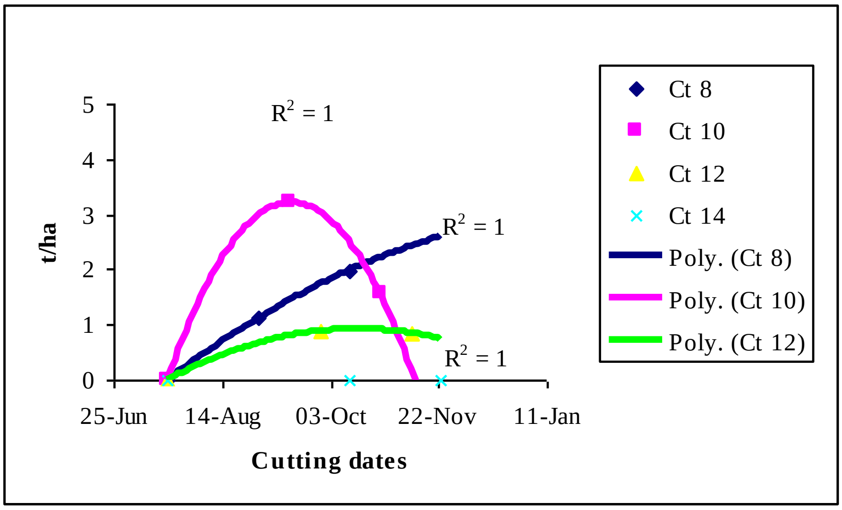

Figure 4.8.3: The influence of cutting treatments on growth of LS 35 stooling rye, planted on 6th July 2007.

According to Figure 4.8.3, LS 35 stooling rye, cut 10 weeks after planting (Ct 10) reach an optimum production peak of 3.1 t/ha in early September and after that re-growth declined. If cut at 8 and 12 weeks after planting it did not reach a peak production (Ct 8 and Ct 12) and re-growth stopped in November.

- Re-growth for LS 62 stooling rye.

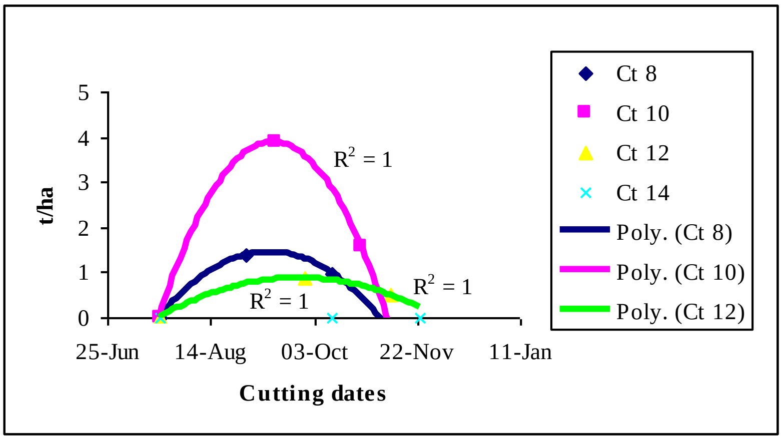

Figure 4.8.4: The influence of cutting treatments on growth of LS 62 stooling rye, planted on 6th July 2007.

According Figure 4.8.4, LS 62 stooling rye that was cut at 8 and 10 weeks after planting reach an optimum production peak of 1.4 t/ha and 4.0 t/ha, respectively, in late August. If cut 12 weeks (Ct 12) after planting, it reached a production peak of 0.9 t/ha in early September. After that re-growth declined.

- Re-growth for Cloc 1 triticale.

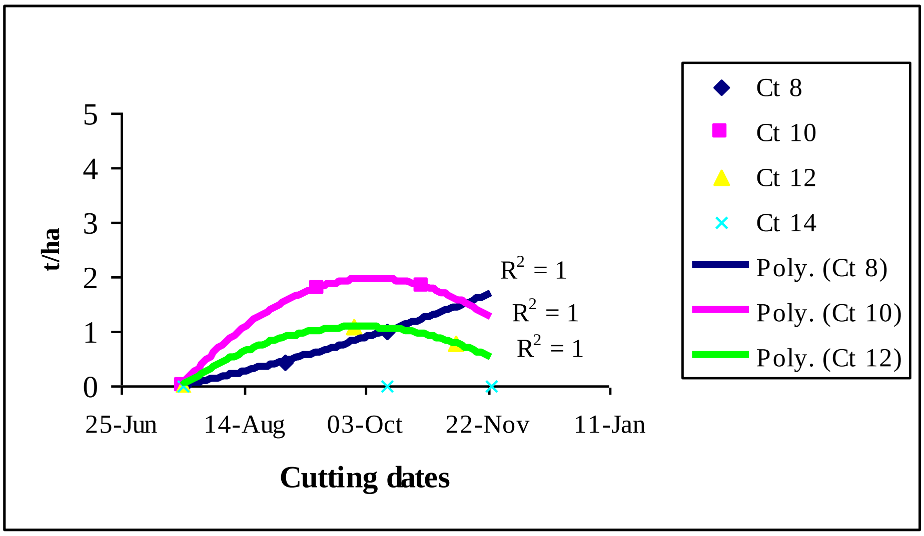

Figure 4.8.5: The influence of cutting treatments on growth of Cloc 1 triticale, planted on 6th July 2007.

According Figure 4.8.5, Cloc 1 triticale that was cut at 10 (Ct 10) and 12 (CT 12) weeks after planting reach an optimum production peak of 2.0 t/ha and 1.0 t/ha, respectively, early October. To cut earlier (Ct 8) Cloc 1 triticale maintain a low production early, but increase to 1.8 t/ha late Noveember.

4.1.5.3 Summary of the 6th July 2007 planting date results

According to Table 4.8 and Figure 4.7.4 LS 62 stooling rye was the highest producer, especially when cut later than 28th September (Ct 10). Figure 4.8.4 illustrated further that the six weekly re-growth rate of the Ct 10 treatment was the highest at the end of August (4 t/ha) and lasted until 18th October. This cultivar can thus be described as a late winter and spring producer.

Witteberg oats was the second highest producer (Table 4.8) and Figure 4.7.1 showed that it produced higher when it was cut initially on 12th September (Ct 10). Figure 4.8.1 confirmed that cutting on the 12th September also had a positive effect on the six weekly re-growth with a peak of 2.9 t/ha at the end of August. This cultivar is also a late winter and spring cultivar, although later initial defoliation (Ct 12) can also be considered, but with a lower reproduction rate (2.2 t/ha) in September (Figure 4.7.4 and 4.8.1).

LS 35 stooling rye planted in July and cut during mid-September (Ct 10) produced 4.5 t/ha (Table 4.8). However, the distribution of the re-growth (Figure 4.8.3) was over a long period with a peak (3.1 t/ha) in early September. With this planting date and cutting conditions LS 35 stooling rye can be described as a winter producer. When cut 8 weeks after planting, re-growth might be low but can last until October/November.

Overberg oats was the highest producer during the reproduction stage (5.73 t/ha). It is the only cultivar that produced above 5.0 t/ha (Table 4.8) in the reproduction stage. This cultivar can also be classified as a high producer and when cut initially at 14th September (Ct 10), its re-growth might continue until October/November (Figure 4.8.2). When cut only late September (Ct 12) the re-growth period is short, but with a peak production of 2.9 t/ha in early September.

Cloc 1 triticale was a low producer (average 2.4 t/ha Table 4.8) when planted in July. It had the potential to re-grow until November if cut at Ct 8, but with low early production (Figure 4.8.5). Cutting in mid-September seemed to give the best re-growth at the end of September.

A final option to produce maximum fodder for the longest period in winter with late planting (July) will be to plant and utilize the following cultivars:

1. Witteberg oats (Ct 10), LS 62 stooling rye (Ct 10) or Overberg oats (Ct 12) for late August and early September utilization. The re-growth of Overberg (Ct 10) will be lower, but have the potential to last until November.
2. LS 35 stooling rye was not a high producer, but the re-growth potential might maintained over a longer period if a combination of Ct 8 and Ct 10 treatment are applied.
3. Although low production, Cloc 1 triticale (Ct 8 and Ct 10) can produce fodder as late as October/November.

4.1.6 Results obtained from the 20th August 2007 planting date.

4.1.6.1 Total dry matter production (DM production).

Table 4.10 represents the total DM production of plots that were planted on the 20th August 2007. The statistical analysis of the data is given in Appendix A.5. Refer to Chapter 3, for an explanation of cutting treatment and explanation of the abbreviation (Ct 8, etc). The different cutting dates for the different cutting treatment were Ct 8 on the 15th October; Ct 10 on the 29th October; Ct 12 on the 12th November and Ct 14 on the 26th November.

Table 4.10: The influence of cutting treatments on the DM production of different winter pasture cultivars, planted the 20th August 2007 at Dewagenings Drift (DWD).

Cultivars	Cutting treatment					Average for cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	Ct 12 + Re-growth	Ct 14 + Re-growth	Repro Stage	
Witteberg	2.46	2.51	2.72	1.42	4.52	2.73a
Overberg	2.53	2.54	2.84	1.55	5.04	2.89a
LS 35	2.42	2.59	3.29	0.80	4.18	2.65a
LS 62	2.18	3.31	2.58	0.94	4.62	2.73a
Cloc 1	2.02	1.70	3.41	0.99	3.68	2.36a
Average	2.32b	2.53ab	2.97ab	1.13b	4.41a	
CV %		14.2 % (Reps)		57.5 % (Treatments)		
LSD						
Interaction	2.96					
Cultivars	1.66					
Cut treat	1.89					

** Ct 8 on the 15st September; Ct 10 on the 29th September; Ct 12 on the 26th October and Ct 14 on the 10th November 2007.*

According to Appendix A.5, a highly significant (P≤ 0.001) interaction occurred between DM yields of cultivars and cutting treatments. The average DM production of cultivars (main effect) did not differ significantly (P≤0.960) from each other. The average DM yields of cutting treatments (as main effects) differed significantly (P≤0.040) from each other.

According to Table 4.10 Overberg oats had the highest DM production (5.04 t/ha) in the reproductive stage, which confirms its classification as Mid-season type. The production of Witteberg oats, LS 35 and LS 62 stooling rye (all in the reproductive stage) did not differ significantly from each other (red in table). Table 4.10 further indicates an intermediate production group (orange in table) which varied between 2.18 and 3.68 t/ha and a low production group which varied between 0.8 t/ha and 1.7 t/ha (yellow in table). If the production values of the three mentioned groups are compared in the (Fishers LSD = 2.96) a tendency existed that most cultivars produced the highest when cut for the first time at reproductive stage. This corresponds with the average production for the reproductive stage, as main effect, which was 4.41 t/ha. The total production at the Ct 14 treatment was, on average, lower (P≤0.04) than that of the reproduction stage cutting. The average production for all five different cultivars (Witteberg oats, Overberg oats, LS 35 stooling rye, LS 62 stooling rye and Cloc 1 triticale) (cultivar as main effect) did not differ significantly (P≤0.960) and were 2.73, 2.89, 2.65, 2.73 and 2.36 t/ha, respectively.

These production trends are also given in Figures 4.9.1 to 4.9.5, where the production pattern, as influenced by initial cutting date, is illustrated more visually.

According to Figure 4.9.1 to 4.9.5 all cultivars produced in low when they were cut on the 26^{th} November (Ct 12). This was most probably induced by the higher minimum temperature in November (Table 4.1). Witteberg and Overberg oats produced between 2.5 and 2.9 t/ha on the 15^{th} October (Ct 8), 29 October (Ct 10) and 12 November (Ct 12). When cut in the reproductive stage, Witteberg oats produced 4.52 t/ha and Overberg oats 5.04 t/ha.

LS 62 stooling rye produced the highest (3.31 t/ha) when cut on the 29^{th} October (Ct 10). LS 35 and Cloc 1 triticale produced the highest when cut on the 12^{th} November (Ct 12), with 3.29 t/ha and 3.41 t/ha, respectively.

LS 62 stooling rye produced 2.58 t/ha when cut on the 12^{th} November (Ct 12) and can thus be classified as the earliest high producer when planted in August

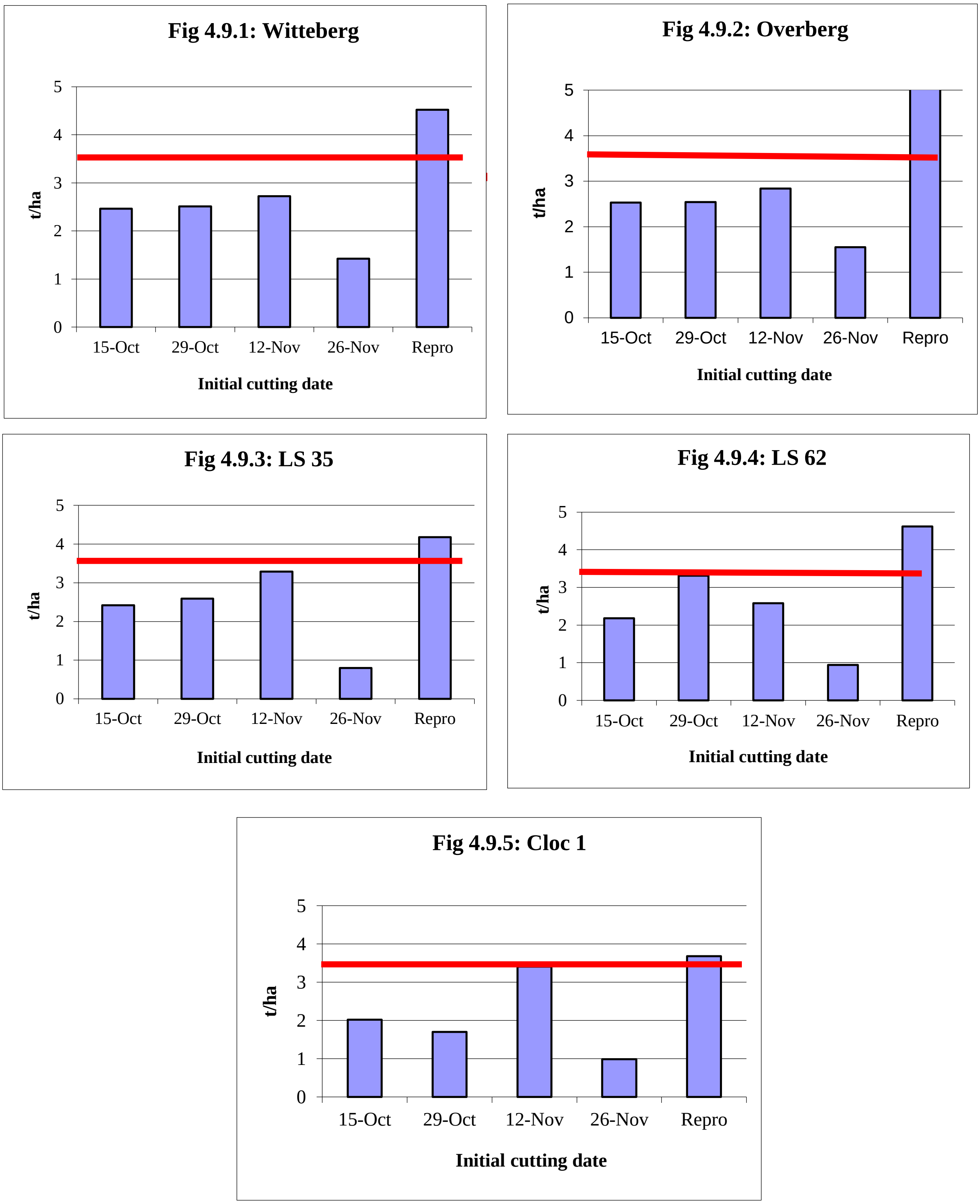

Figure 4.9.1 to 4.9.5: The production pattern of the five winter fodder cultivars planted 20th August 2007, as influenced by initial cutting date.

4.1.6.2 Re-growth tempo of the five winter fodder crop cultivars planted in August 2007.

The exact cutting dates of the re-growth at the different cutting treatments are given in Table 4.11.

Table 4.11: Cutting dates of re-growth for the 20th August 2007 planting date

Cutting Treatments	Cutting dates of re-growth	
	Initial Cut	1st re-growth
Ct 8	15 Oct	26 Nov
Ct 10	29 Oct	10 Dec

NB: Re-growth stopped after first re-growth cut.

The re-growth (t/ha DM) obtained on the dates indicated in Table 4.11, were used to fit trend lines (seasonal re-growth) for each cultivar and cutting treatment. These trend lines are shown in Figure 4.10.1 to 4.10.5 for each cultivar

- Re-growth for Witteberg oats.

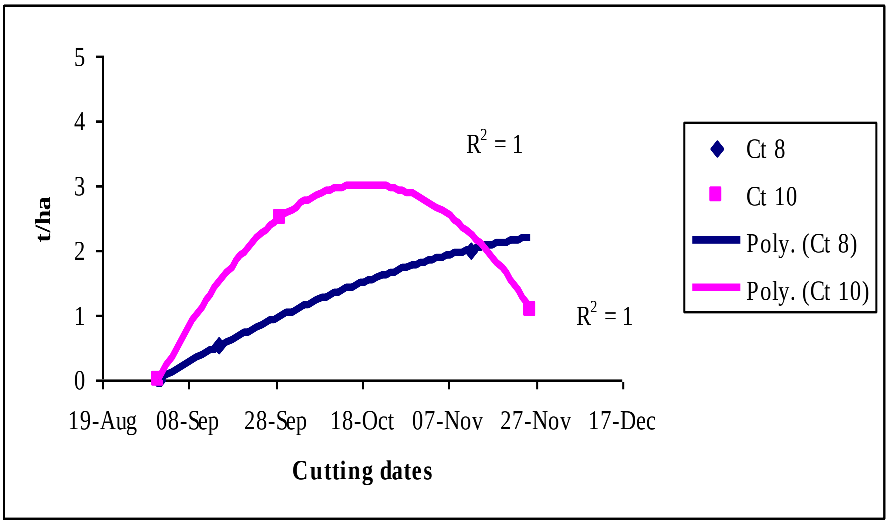

Figure 4.10.1: The influence of cutting treatments on growth of Witteberg oats, planted on the 20th August 2007.

According to Figure 4.10.1, Witteberg oats, cut on the 29th October (Ct 10), reached an optimum production peak of 2.8 t/ha in late September and after that re-growth declined. The initial cut after 8 weeks (Ct 8) did not reach an optimum DM production before November. After this date, no re-growth was measured.

According to Figure 4.10.2, Overberg oats, cut on the 15th October (Ct 10), reached an optimum production peak of 2.0 t/ha in Mid-October and after that re-growth declined. The initial cut after 8 weeks did not reach optimum DM production before November.

➢ Re-growth for Overberg oats.

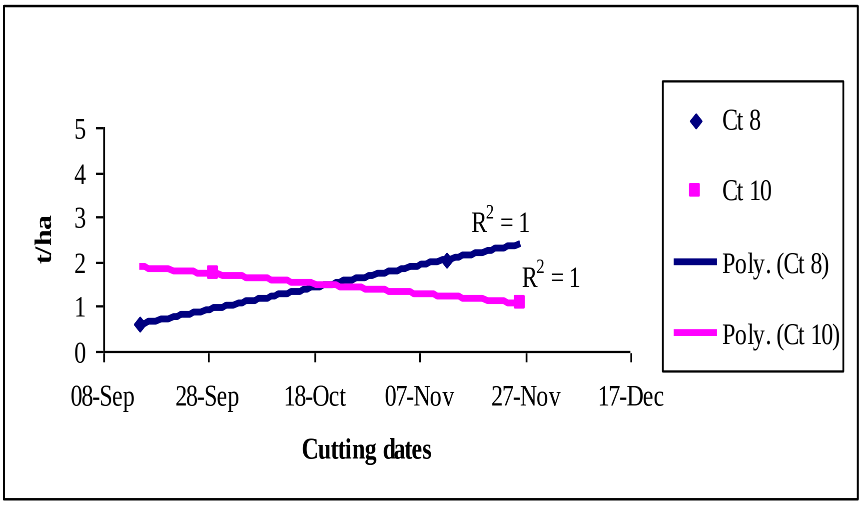

Figure 4.10.2: The influence of cutting treatments on growth of Overberg oats, planted on the 20th August 2007.

➢ Re-growth for LS 35 stooling rye.

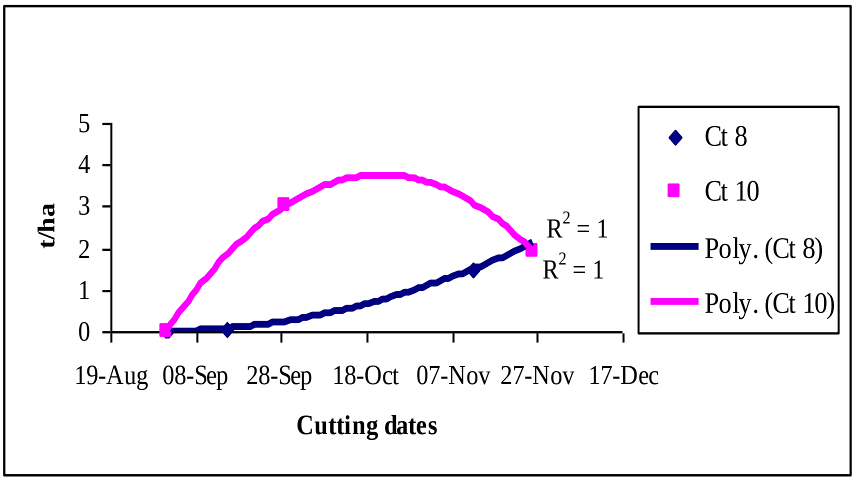

Figure 4.10.3: The influence of cutting treatments on growth of LS 35 stooling rye, planted on the 20th August 2007.

According to Figure 4.10.3, LS 35 stooling rye, cut 10 weeks after planting (Ct 10), reached an optimum production of 3.5 t/ha in early October and after that re-growth declined. The cut after 8 weeks did not reach optimum DM production before November.

➢ Re-growth for LS 62 stooling rye.

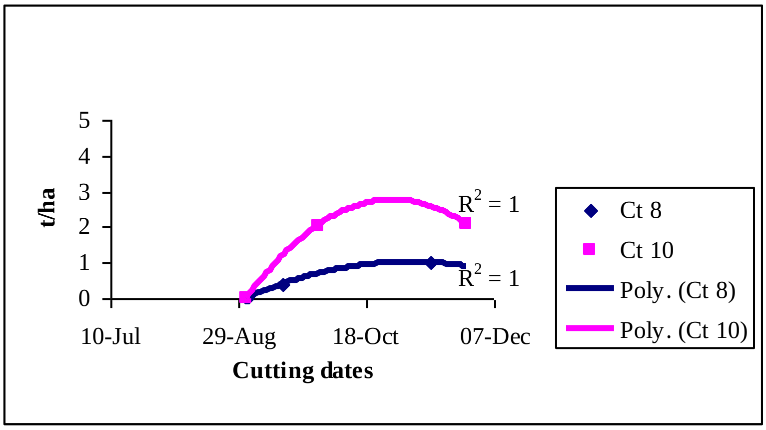

Figure 4.10.4: The influence of cutting treatments on growth of LS 62 stooling rye, planted on the 20th August 2007.

According to Figure 4.8.4, LS 62 stooling rye, cut 10 weeks after planting (Ct 10) reached an optimum production peak of 2.5 t/ha in Mid-October and after that re-growth declined. The cut after 8 weeks did not reach optimum DM production before late October.

➢ Re-growth for Cloc 1 triticale.

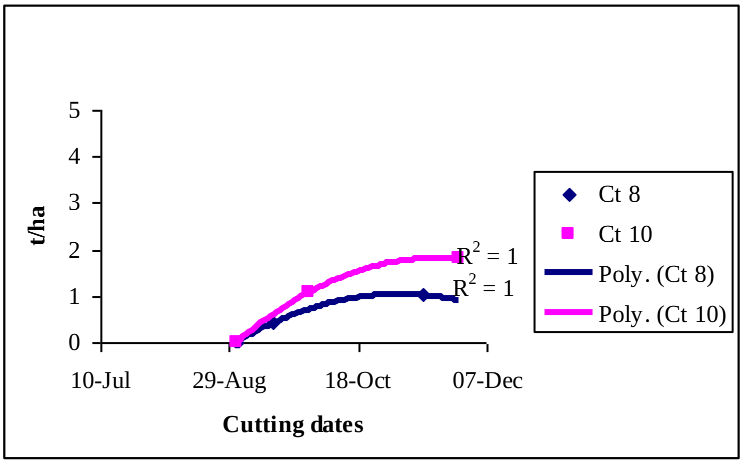

Figure 4.10.5: The influence of cutting treatments on growth of Cloc 1 triticale, planted on the 20th August 2007.

According to Figure 4.10.5, Cloc 1 triticale, cut 8 and 10 weeks after planting (Ct 8 and Ct 10), did not reach optimum DM production before November.

4.1.6.3 Summary of the 20th August 2007 planting date results

According to Table 4.10 and Figure 4.9.5 Cloc 1 triticale was the highest producer, especially when cut early (13th August). Figure 4.9.5 illustrated further that the six weekly re-growth rate of Ct 10 was the highest and lasted until the November. This cultivar can thus be described as a late winter and spring producer.

LS 62 Stooling rye was the second highest producer (Table 4.10) and Figure 4.9.4 showed that it produced highest when it was cut on the 29th September. Figure 4.10.4 confirmed that the early initial cut (Ct 10 in September) also had a positive effect on the six weekly re-growths. This cultivar is also a late winter and spring cultivar, as it lasted until the 7th November (Figure 4.10.4).

LS 35 Stooling rye followed the same production trend as Cloc 1 triticale and LS 62 stooling rye (late winter and spring producer) when deteriorated on the 13th October (Ct 12). The re-growth was lower but the production period was longer. It can be defoliated later than the 7th November.

According to Table 4.10, Overberg and Witteberg oats produced low during all cutting treatments (Ct 8, Ct 10,and Ct 12) but did good during the reproduction stage (5.04 t/ha and 4.52 t/ha). Figure 4.9.1 and 4.9.2 confirmed that even these cultivars can be utilized late in the season for hay making, (Figure 4.10.1 and 4.10.2).

A final option to produce maximum fodder for the longest period in winter with late planting (August) will be to plant and utilize the following cultivars.

1. Cloc 1 triticale (Ct 12) and/or LS 62 stooling rye (Ct 10) for September to October utilization.
2. LS 35 stooling rye (Ct 10) or LS 62 stooling rye (Ct 10) for October to November utilization.
3. Witteberg oats in the reproduction stage, since it produced the best during this stage it will be suitable for hay.

4.1.7 Results obtained from the 26th September 2007 planting date.

4.1.7.1 Dry matter production (DM production).

Table 4.12 represents the DM production of plots that were planted on the 26th September 2007. The statistical analysis of the data is given in Appendix A.6. The different cutting dates on the different treatment were Ct 8 on the 21st November; Ct 10 on the 5th December.

Table 4.12: The influence of cutting treatments on the DM production of different winter pasture cultivars, planted the 26th September 2007 at Dewageningsdrift.

Cultivars	Cutting treatment		Average for Cultivars
	Ct 8 + Re-growth	Ct 10 + Re-growth	
Witteberg	0.70	1.78	1.24a
Overberg	0.72	1.66	1.19a
LS 35	0.75	1.43	1.09a
LS 62	0.98	1.71	1.35a
Cloc 1	0.42	1.38	0.90a
Average	0.72b	1.59a	
CV %	2.2 % (Reps)	26.6 % (Treatments)	
	LSD		
Interaction	0.58		
Cultivars	0.52		
Cut treat	0.27		

Ct 8 on the 8stNovemberr; Ct 10 on the 22nd November.

According to Appendix A.6 cultivar (main treatment) did not influenced DM production significantly (P≤ 0.423), neither did the interaction (P≤ 0.768) between cultivars and cutting treatments. Cutting treatments (as main effects) influenced DM production significantly (P≤0.005). According to Table 4.12, Witteberg oats, Overberg oats and LS 62 stooling rye produced more than 1.6 t/ha that was significantly higher the rest of the treatments (Fisher's protected LSD = 0.58). The initial cut at 10 weeks after planting (Ct 10) resulted in an average DM production of 1.59 t/ha that was significantly (P≤0.005) higher than average production (0.72 t/ha) at the Ct 8 cutting treatment.

4.1.7.3 Summary of the 26th September 2007 planting date results

All five cultivars (Witteberg oats, Overberg oats, LS 35 stooling rye, LS 62 stooling rye and Cloc 1 triticale) did not produce well when planted in late September. The total production was lower than 2.0 t/ha for all cutting treatments. Although a farmer in serious need for green grazing can plant Witteberg oats, Overberg oats and LS 62 stooling rye late in September and will have feed available end of November and early December.

4.1.8 Nutritional value of the winter fodder crops, planted in April at Dewageningsdrift.

4.1.8.1 Chemical analysis

The chemical analysis was done according to the Van Soest (1965) method by the accredited Feed laboratory of the KwaZulu Natal Department of Agriculture and Environmental Affairs. The parameters that were evaluated were the crude protein (CP), acid detergent fiber (ADF) and neutral detergent fiber (NDF), that is according to Kalu and Fick (1983) and Fick and Mueller (1989) some of the most important parameters to evaluates fodder,

Acid Detergent Fiber (ADF)

According to Tainton (1999) ADF represents mainly the cell wall (fibrous) components of the plant material and includes cellulose, hemicellulose, lignin, cutin, silica and tannins. These components are partly soluble in acid and from there the name acid detergent fibre. Blezinger (1999) quoted an ADF % of between 31 and 40% as good to very good in quality. When it ranges between 41 to 42% it can be described as medium quality and when higher than 42% as low in quality

Neutral Detergent Fiber (NDF)

Neutral Detergent Fiber represents the cell content of the plant material that includes carbohydrates, starch, organic acids, pectin and protein. These components are soluble in neutral detergents and from there the name neutral detergent fiber (Tainton 1999). Blezinger (1999) described forage with a NDF % of below 46 % as very good, 47 % to 60% as medium to good and above 61% as low.

Crude Protein content

Tainton (1999) described proteins in fodder crops and ruminant feeds as follows: “The general term used is Crude protein (CP) and is made up by natural proteins and non-protein (NPN). The NPN is not really useful to the ruminant”. To calculate the CP, the nitrogen (N) content of the material as analyzed in the laboratory is multiplied by 6.25. In general, a minimum CP of between 7% and 8% is required by ruminants for maintenance, while high producing animals require levels above 13%.

4.1.8.2 Nutritional value of the five winter fodder crops.

The nutritional value of the winter fodder crops planted in April 2007 on Dewageningsdrift is shown in Table 4.13.

Table 4.13: The nutritional value (ADF %, NDF % and CP %) of the five winter fodder crops at different regrowth stages, planted in April, at Dewageningsdrift.

Cultivars	Cutting Treatments	ADF %	NDF %	Crude protein %
Witteberg oats	8 weeks	23.07	44.37	11.63
	10 weeks	-	-	-
	12 weeks	22.41	39.21	8.62
	14 weeks	22.81	39.46	18.34
	Matured	31.32	52.52	20.02
	Average	**24.90**	**43.89**	**14.65**
Overberg oats	8 weeks	20.65	34.74	12.39
	10 weeks	19.85	32.28	12.02
	12 weeks	24.49	39.83	19.70
	14 weeks	21.44	38.45	14.82
	Matured	37.28	51.51	9.19
	Average	**24.74**	**39.36**	**13.62**
LS 35 stooling rye	8 weeks	-	-	-
	10 weeks	27.77	43.54	18.36
	12 weeks	29.52	48.24	13.74
	14 weeks	25.43	44.03	11.53
	Matured	24.91	39.76	19.71
	Average	**26.91**	**43.96**	**15.84**
LS 62 stooling rye	8 weeks	25.34	36.76	17.71
	10 weeks	26.64	38.53	22.03
	12 weeks	27.79	44.93	22.64
	14 weeks	22.95	37.86	15.91
	Matured	36.66	56.83	12.37
	Average	**27.88**	**42.98**	**18.13**
Cloc 1 triticale	8 weeks	26.00	39.70	14.14
	10 weeks	-	-	-
	12 weeks	25.38	43.53	15.18
	14 weeks	25.75	43.63	20.87
	Matured	-	-	-
	Average	**25.71**	**42.29**	**16.72**

NB: The nutritional values of some treatments are not shown in the table due to the fact that they were destroyed in a fire, during the drying process.

The CP % of Witteberg oats tends to be higher in a more matured stage (18.34 % at CT14 and 20.02 % in a matured stage). Overberg oats showed the same trend although lower in the reproductive stage. The CP % of LS 35 stooling rye was on average 15.84 %, with a high 19.71 % in the matured stage and only 11.5 % at Ct 14. The average CP % of LS 62 stooling rye was 18.13 % (range 15.91 % to 22.64 %) with an expected lower CP % in the matured stage (12.37 %).

Cloc 1 triticale was the most affected by the fire in the oven, but the CP % varied between 14.14 % and 20.87 %.

The ADF % of all five fodder cops were below 30 %, when cut 14 weeks after planting (Ct 14) or earlier. The ADF % of LS35 stooling rye, in the matured stage, was still 24.9 %, while that of the other crops were above 31 %, which is still good quality. The ADF % of two oats cultivars was on average the lowest (24.74 % and 24.9 %).

The NDF % of all five fodder cops were below 46 %, when cut 14 weeks after planting (Ct 14) or earlier, except LS 35 stooling rye at Ct 12 (48.24 %). Values of lower than 46 % can be described as very good. During the matured stage the NDF % of four of the fodder crops (except LS 35 stooling rye) was between 50 % and 57 %, which is still classified as medium quality.

4.1.8.3 Summary of the nutritional value of the five winter fodder crops.

The fact that the nutritional value of temperate species is better than that of sub-tropical species is well documented in the literature and also visible in the results in this study. In general it can be concluded that livestock will gain weight on all five winter fodder crops. There is a tendency that the nutritional values were lower in the matured stage, but still good enough to maintain animal weight.

The two oats cultivars tend to be of lower quality in the younger stage, but still good enough to maintain animal weight

4.2 NOOIGEDACHT RESULTS (ERMELO, MPUMALANGA)

4.2.1 Meteorological results

The monthly climatic data (2007 season), at the Nooigedacht Agricultural Development Center (ADC) is shown in Table 4.14.

According to Table 4.14, there was no rain during January 2007 and that could have had a negative impact on the germination and early DM production of all cultivars. However, it should be kept in mind that irrigation was applied at 25 mm/week since establishment. The higher rainfall received during October could have had a positive impact on the DM production during the third Cut (Table 4.16). Only one planting date (2nd February 2007) was used.

Table 4.14: The Monthly rainfall data for 2007 at the Nooigedacht (ADC).

2007	**Rain (mm)**
January	0.0
February	44
March	78.6
April	11.2
May	0.0
June	0.0
July	0.0
August	0.0
September	7
October	256.7
November	82.6
December	45.8
Total	**525.9**

4.2.2 Dry matter production at different cutting dates.

According to Appendixes B1, B2, B3 and B5, significant differences in DM production, between cultivars, were measured during cutting dates 1, 2, 3 and 5. On the 25th September 2007 (4th cutting date) no significant differences occurred. The results obtained on these cutting dates are given in Table 4.15 and Figures 4.11.1 to 4.11.5

Table 4.15: The average monthly DM Production (t/ha) of the five winter fodder crops, planted 2nd February 2007, at Nooitgedacht (Mpumulanga).

	Cutting dates				
Cultivars	**03 July 2007**	**31 July 2007**	**28 Aug 2007**	**25 Sept 2007**	**23 Oct 2007**
Witteberg	0.245 c	0.277 b	4. 773 c	0.624 a	0.310 b
Overberg	0.683 c	0.196 b	3.479 d	1.098 a	0.419 a
LS 35	1.936 c	0.625 a	5.145 bc	0.662 a	0.000 c
LS 62	1.300 c	0.637 a	6.477 a	0.287 a	0.000 c
Cloc 1	0.218 c	0.543 a	5.589 b	0.581 a	0.000 c
Average	**0.87b**	**0.45b**	**5.08a**	**0.64b**	**0.14b**
P Value*	P≤0.001	P≤0.001	P≤0.001	P≤0.122	P≤0.001
LSD (5%)	0.534	0.184	0.579	0.595	0.064
CV%	50.6	33.4	9.4	75.9	36.5

According to Table 4.15, LS 35 stooling rye and LS 62 stooling rye showed had the highest DM production (1.93 and 1.30 t/ha) during the first cut, which did not differ significantly from that of the other three cultivars (P≤0.001).

During the second cut the two stooling rye cultivars (LS 35, LS 62) and Cloc 1 triticale had the highest DM production (0.62, 0.63 and 0.54 t/ha). It did not differ significantly (P≤0.001) from each other, but was significantly higher than that of Witteberg and Overberg oats.

During the third cut, LS 62 stooling rye had the highest DM production, which was significantly higher (P≤0.001) than that of all other cultivars.

During the fourth cut, the production did not differ significantly (P≤0.122) from each other. Overberg oats produced the highest (1.09 t/ha), while the production of the other four cultivars varied between 0.28 and 0.66 t/ha.

During the fifth cut, LS 35 and LS 62 stooling rye and Cloc 1 triticale had no re-growth. Overberg oats produced 0.419 t/ha. It was significantly higher (P≤0.001) than the 0.31 t/ha of Witteberg oats.

4.2.3 Seasonal distribution of re-growth.

The seasonal re-growth trends of each cultivar are illustrated in Figures 4.11.1 to 4.11.5.

The two stooling rye cultivars (LS 62 in Figure 4.11.1 and LS 35 in Figure 4.11.2) were the two earliest producers, at Nooitgedacht ADC. Both produced more than 1.0 t/ha in July and more than 5.0 t/ha in August, which made them Mid to late winter producers.

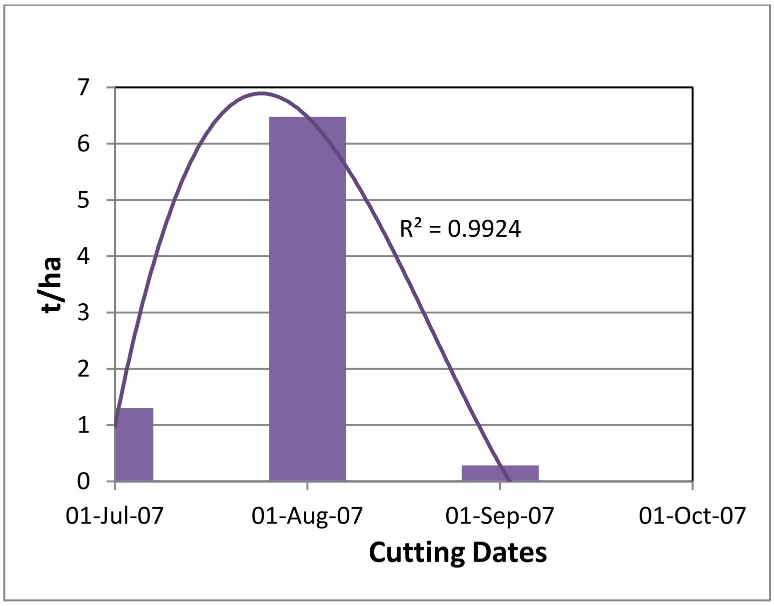

Figure 4.11.1: The re-growth trend of LS 62 stooling rye.

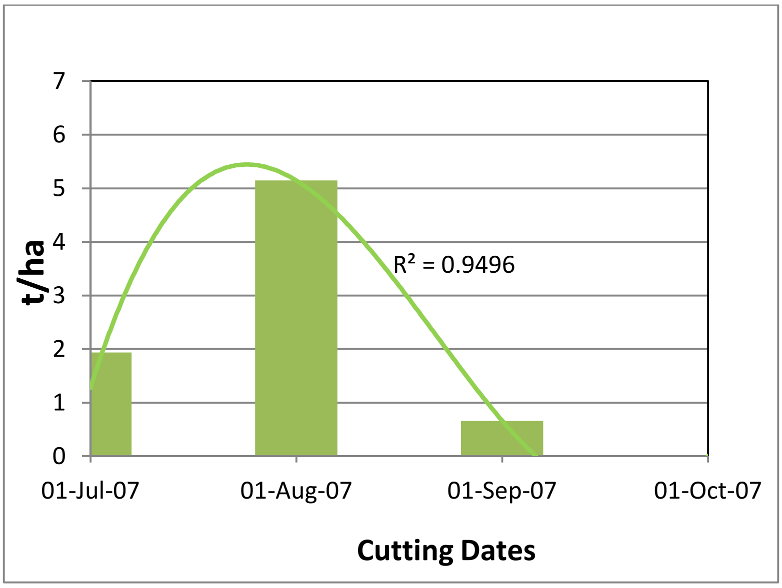

Figure 4.11.2: The re-growth trend of LS 35 stooling rye.

Overberg oats (Figure 4.11.3) was in total a relative low producer (5.8 t/ha), but with a DM production of more than 1.0 t/ha in September, that made it a late winter producer in the cooler Mpumalanga.

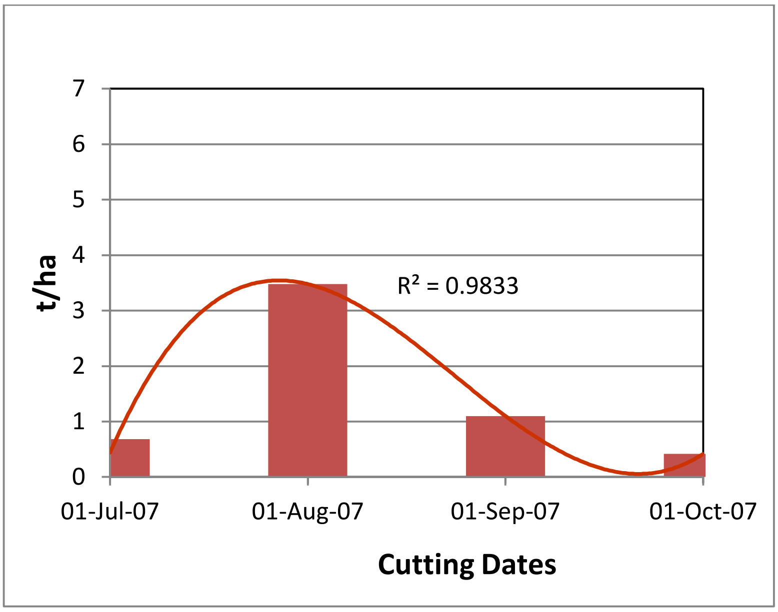

Figure 4.11.3: The re-growth trend of Overberg oats.

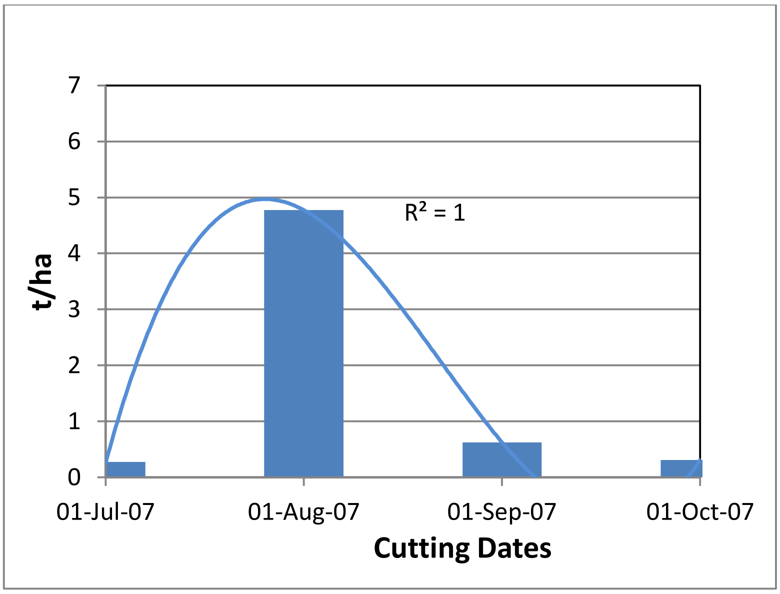

Figure 4.11.4: The re-growth trend of Witteberg oats.

The total production of Witteberg oats was 6.169 t/ha and according to Figures 4.11.4 this cultivar can be classified as a late-winter producer.

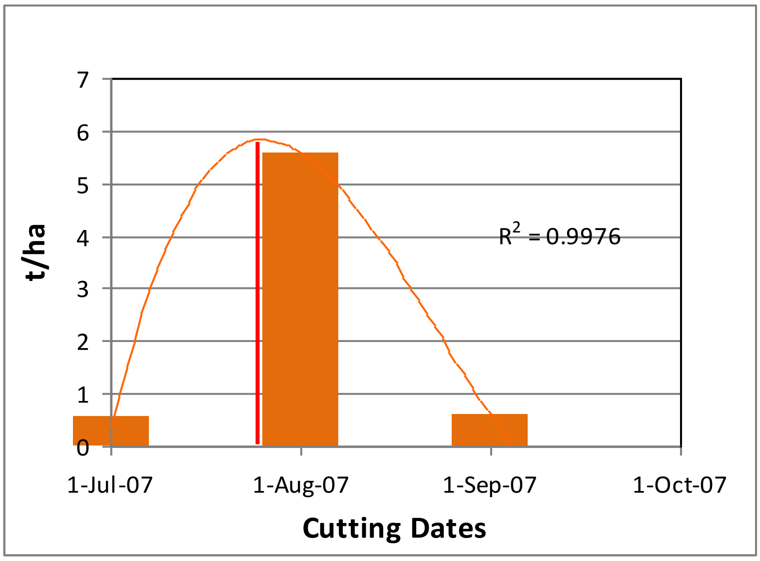

Figure 4.11.5: The re-growth trend of Cloc 1 triticale.

The total production of Cloc 1 was 6.93 t/ha and according to Figure 4.11.5, the production peak was at the beginning of August, with relative low production early July and September. Accordingly it seems to be a late-winter production cultivar.

4.2.4 Total Dry matter production

The total dry matter production of the five winter fodder crops (Witteberg oats, Overberg oats, LS 35 stooling rye, LS 62 stooling rye and Cloc 1 triticale) at Nooigedacht ADC is given in Table 4.11. The statistical analysis of the results is given in Appendix B.6 and showed significant differences ($P \leq 0.001$) between cultivars.

Table 4.16: The total DM Production (t/ha) of the five winter fodder crops at the Nooitgedacht ADC.

Cultivar	DM production (t/ha)
LS 62 stooling rye	8.701 a
LS 35 stooling rye	8.368 a
Cloc 1 triticale	6.930 b
Witteberg oats	6.169 bc
Overberg oats	5.804 c
LSD ($P \leq 0.001$)	0.8895
CV %	7.8 %

The total DM production of LS 62 and LS 35 stooling rye (8.70 and 8.368 t/ha, respectively) did not differ significantly from each, but was significantly higher than the rest. Cloc 1 triticale (6.93 t/ha) produced significantly higher than Overberg oats (5.804 t/ha), but not significantly higher than Witteberg oats (6.169 t/ha).

According to Table 4.17, LS 62 stooling rye produced the highest, (8.70 t/ha). That was because of the relative high production of the first cut (3 July) and the high production of re-growth in 31st July.

4.2.5. Summary of the performance of the five winter growing fodder crops at Nooitgedacht ADC.

The two stooling rye cultivars (LS 35 and LS 62) were the highest producers, followed by Cloc 1 triticale and Witteberg and Overberg oats .

Under the cool climate of Nooitgedacht ADC, Mpumalanga, the two stooling rye cultivars could be classified as early to mid-winter producers, Cloc1 triticale and Witteberg oats as mid-winter producers and Overberg oats as a late winter producer.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

THE EFFECT OF PLANTING DATES AND CUTTING TREATMENTS ON THE PRODUCTION OF FIVE SELECTED WINTER CEREALS PLANTED AT DEWAGENINGS DRIFT (GAUTENG PROVINCE) AND NOOITGEDACHT ADC (MPUMALANGA)

5.1 CONCLUSIONS

5.1.1 Dewageningsdrift, Gauteng

Planted on the 5th April 2007

LS 62 stooling rye and Cloc 1 triticale were on average the highest producers (above 6.0 t/ha) when defoliated initially 14 weeks after planting. On average this defoliation treatment (Ct 14) resulted in the highest production for all cultivars.

Planted in April LS 62 stooling rye and Cloc 1 triticale can be described a late winter/spring producing cultivars. Earlier utilization/defoliation (Ct 12) of LS 62 stooling rye can be considered, although with a lower production.

When defoliated in June (Ct 12), Witteberg oats followed the same production trend than Cloc 1 triticale and LS 62 stooling rye and that is late winter/spring production. The re-growth rate was lower but the production period longer until the 18th October.

LS 35 stooling rye produced the lowest re-growth (±3.0 t/ha), but it was available late winter/spring.

Defoliating Overberg oats earlier (10 weeks after planting) made it a mid-winter growing cultivar. When defoliation started later (after 14 weeks) it became a spring producer.

Planted on the 4th May 2007

LS 62 stooling rye and Witteberg oats was the highest producers, followed by Cloc 1 triticale and the rest, when planted in May.

LS 62 stooling rye and Witteberg planted in May and utilize/defoliated 14 weeks after planting made it a late winter/spring fodder (September to October). LS 62 stooling rye and Cloc 1 triticale can also be utilized from 12 July (Ct 10) onwards for optimum production in mid-winter.

LS 35 stooling rye and Overberg can be utilized from 12 and 14 weeks after planting (May) for July to September production. If LS 35 stooling rye is defoliated from 10 weeks after planting, it can supply fodder in July/August

Planted in June 2007

Overberg oats defoliated 8 weeks after planting (1 August) can supply fodder in July and August. Witteberg oats, Cloc 1 triticale and both stooling ryes (LS 35 and LS 62) produced the highest in late August/September when defoliated initially early August .

Planted in July 2007

Witteberg oats and LS 62 stooling rye, planted in July, produced the highest (above 7.5 t/ha) of the five cultivars. If these two cultivars are defoliated initially early September (10 weeks) it can produce in September/October. Witteberg oats defoliated initially late September can produce as late as mid-November. Cloc 1 triticale, defoliated initially late August, will produce as late as November (up to 3.7 t/ha).

Planted on the 20th August 2007

Planting late August is already late, however it seems that early utilization (8 to 10 weeks after planting), for all five cultivars, can result in available fodder late in September/October/November.

Planted on the 20th September 2007

All five cultivars (Witteberg oats, Overberg oats, LS 35 stooling rye, LS 62 stooling rye and Cloc 1 triticale) did not produce well when planted in late September. The total production was lower than 2.0 t/ha for all cutting treatments. Although a farmer in serious need for green grazing can plant Witteberg oats, Overberg oats and LS 62 stooling rye late in September and will have feed available end of November and early December.

5.1.2 Nutritional value of the five winter cereal cultivars

The acid detergent fiber (ADF %) of all five cultivars was below 30%, in a young stage. During the matured stage the ADF % of LS 62 stooling, Witteberg and Overberg raised higher than 30 %.

The neutral detergent fiber (NDF %) of all five cultivars was below 45 % in the a young stage. During the matured stage the NDF % of LS 62 stooling, Witteberg and Overberg oats became higher than 50 %.

The crude protein content was in most cases above 14 %, except Witteberg and Overberg oats, in a young stage, and Overberg oats and LS 62 stooling rye in a matured stage,

These high nutritional values are indicators that animals grazing this winter fodder will be able to gain weight.

5.1.3 Nooigedacht ADC, Mpumalanga.

The two stooling rye cultivars (LS 35 and LS 62) were the highest producers, followed by Cloc 1 triticale and Witteberg and Overberg oats, while Witteberg oats and LS 62 stooling rye were the best producers on Dewageningsdrift.

LS35 stooling rye and Cloc 1 triticale produced relatively high when planted earlier (April).

Under the cool climate of Nooitgedacht ADC, Mpumalanga, the two stooling rye cultivars could be classified as early to mid-winter producers, Cloc1 triticale and Witteberg oats as mid-winter producers and Overberg oats as a late winter producer.

5.2 RECOMMENDATIONS

Planting dates and the two different localities did influence the time of optimum production of the five winter fodder crops, as indicated in Table 5.1.

Table 5.1: The impact of planting date on the optimum production period of the different winter fodder cultivars.

Species	Cultivar	Locality	Planting date	Mid-winter growth	Late winter/ Spring growth	Spring Growth
Stooling rye	LS 35	Nooitgedacht, Cool*	February	X		
		Dewageningsdrift, Warmer	April	X	X	
			May	X		
			June		X	
			July			X
			August			X
			September			X
	LS 62	Nooitgedacht, Cool*	February	X		
		Dewageningsdrift, Warmer	April		X	X
			May		X	
			June		X	
			July			X
			August			X
			September			X
Oats	Overberg	Nooitgedacht, Cool*	February		X	
		Dewageningsdrift, Warmer	April	X		
			May		X	
			June		X	
			July		X	
			August			X
			September			X
	Witteberg	Nooitgedacht, Cool*	February	X		
		Dewageningsdrift, Warmer	April		X	
			May		X	
			June		X	
			July			X
			August			X
			September			X
Triticale	Cloc 1	Nooitgedacht, Cool*	February	X		
		Dewageningsdrift, Warmer	April		X	
			May		X	
			June		X	
			July		X	
			August			X
			September			X

*** On Nooitgedacht only one planting date (2nd February) was used*

According to the information in Table 5.1, the following suggestions in terms of planting dates, for optimum production during winter, can be made:

1) LS 35 stooling rye and Overberg oats planted early (February to April) can act as mid-winter producers on both localities, Cloc 1 triticale reacted like that on Nooitgedacht alone.
2) The following planting dates can be recommended for different cultivars to become late-winter producers:
   - LS 35 – April
   - LS 62 – April to June
   - Overberg – May to July (Nooitgedacht – February)
   - Witteberg – May to June
   - Cloc 1 – April to July
3) The following planting dates can be recommended for different cultivars to become spring producers:
   - LS 35 – July to September
   - LS 62 – July to September
   - Overberg – August to September
   - Witteberg – July to September
   - Cloc 1 – August to September

5.2.1 Need for future research

More research on the drought resistance of the different winter fodder crops is suggested.

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APPENDIX A.1

STATISTICAL ANALYSIS DEWAGENINGSDRIFT: PLANTING DATE APRIL 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	9.550	4.775		
REP.WPLOT stratum					
CULTIVAR	4	46.132	11.533	4.96	0.026
Residual	8	18.612	2.327	1.63	
REP.SPLOT stratum					
GRSTAGE	4	58.564	14.641	7.44	0.008
Residual	8	15.738	1.967	1.38	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	16	95.878	5.992	4.19	<.001
Residual	32	45.774	1.430		
Total	74	290.249			

Tables of means
===========

Variate: Yield

Grand mean 3.749

CULTIVAR	1	2	3	4	5
	3.653	2.624	3.376	4.101	4.989

GRSTAGE	1	2	3	4	5
	3.184	3.138	3.820	5.440	3.161

CULTIVAR GRSTAGE	1	2	3	4	5
1	3.257	2.716	4.120	5.678	2.496
2	2.273	2.510	2.591	3.887	1.861
3	3.544	3.657	4.247	4.652	0.778
4	3.670	3.920	4.360	6.382	2.174
5	3.176	2.890	3.784	6.603	8.493

Standard errors of means

Table	CULTIVAR	CUT STAGE	CULTIVAR CUT STAGE
rep.	15	15	3
e.s.e.	0.3938	0.3621	0.7565
d.f.	8	8	42.46

Except when comparing means with the same level(s) of

CULTIVAR	0.7160
d.f.	39.24
CUT STAGE	0.7325
d.f.	38.11

Least significant differences of means (5% level)

Table	CULTIVAR	CUT STAGE	CULTIVAR CUT STAGE
rep.	15	15	3
l.s.d.	1.2843	1.1810	2.1584
d.f.	8	8	42.46

Except when comparing means with the same level(s) of

CULTIVAR	2.0476
d.f.	39.24
GRSTAGE	2.0969
d.f.	38.11

Stratum standard errors and coefficients of variation
==

Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.4370	11.7
REP.WPLOT	8	0.6821	18.2
REP.SPLOT	8	0.6273	16.7
REP.WPLOT.SPLOT	32	1.1960	31.9

APPENDIX A.2

STATISTICAL ANALYSIS DEWAGENINGS DRIFT: PLANTING DATE MAY 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	11.459	5.730		
REP.WPLOT stratum					
CULTIVAR	4	55.146	13.786	2.29	0.148
Residual	8	48.209	6.026	1.48	
REP.SPLOT stratum					
GRSTAGE	4	96.884	24.221	5.34	0.022
Residual	8	36.279	4.535	1.12	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	16	92.188	5.762	1.42	0.194
Residual	32	129.859	4.058		
Total	74	470.023			

Tables of means
===========

Variate: Yield
Grand mean 4.892

CULTIVAR	1	2	3	4	5
	4.047	3.874	4.820	5.698	6.020

GRSTAGE	1	2	3	4	5
	4.248	5.057	5.202	6.695	3.258

CULTIVAR	GRSTAGE 1	2	3	4	5
1	3.795	3.662	3.761	7.302	1.716
2	2.821	3.863	4.926	5.439	2.321
3	6.135	3.770	5.010	5.913	3.274
4	3.643	6.973	7.554	8.184	2.136
5	4.848	7.015	4.758	6.636	6.841

Standard errors of means

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
e.s.e.	0.6338	0.5498	1.2311
d.f.	8	8	44.02

Except when comparing means with the same level(s) of

CULTIVAR	1.1766
d.f.	39.92
GRSTAGE	1.2182
d.f.	38.79

Least significant differences of means (5% level)

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
l.s.d.	2.0670	1.7931	3.5089
d.f.	8	8	44.02

Except when comparing means with the same level(s) of

CULTIVAR	3.3633
d.f.	39.92
GRSTAGE	3.4852
d.f.	38.79

Stratum standard errors and coefficients of variation
=======================================

Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.4787	9.8
REP.WPLOT	8	1.0978	22.4
REP.SPLOT	8	0.9523	19.5
REP.WPLOT.SPLOT	32	2.0145	41.2

APPENDIX A.3

STATISTICAL ANALYSIS DEWAGENINGS DRIFT: PLANTING DATE JUNE 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	1.198	0.599		
REP.WPLOT stratum					
CULTIVAR	4	15.920	3.980	1.75	0.233
Residual	8	18.241	2.280	1.25	
REP.SPLOT stratum					
GRSTAGE	31	1.194	37.065	29.63	<.001
Residual	6	7.506	1.251	0.69	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	12	31.688	2.641	1.45	0.211
Residual	24	43.699	1.821		
Total	59	229.447			

Tables of means
============

Variate: Yield
Grand mean 2.736

CULTIVAR	1	2	3	4	5
	2.317	2.204	3.573	3.075	2.510

GRSTAGE	1	2	3	4
	3.302	4.550	2.240	0.850

CULTIVAR GRSTAGE	1	2	3	4
1	3.203	2.350	2.609	1.105
2	2.741	3.476	1.996	0.601
3	3.729	7.218	2.545	0.801
4	4.254	5.062	2.165	0.820
5	2.583	4.644	1.887	0.924

Standard errors of means

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	12	15	3
e.s.e.	0.4359	0.2888	0.7792
d.f.	8	6	35.75

Except when comparing means with the same level(s) of	
CULTIVAR	0.7543
d.f.	29.47
GRSTAGE	0.8033
d.f.	31.67

Least significant differences of means (5% level)

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	12	15	3
l.s.d.	1.4216	0.9993	2.2356
d.f.	8	6	35.75

Except when comparing means with the same level(s) of	
CULTIVAR	2.1802
d.f.	29.47
GRSTAGE	2.3149
d.f.	31.67

Stratum standard errors and coefficients of variation
======================================

Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.1730	6.3
REP.WPLOT	8	0.7550	27.6
REP.SPLOT	6	0.5002	18.3
REP.WPLOT.SPLOT	24	1.3494	49.3

APPENDIX A.4

STATISTICAL ANALYSIS DEWAGENINGS DRIFT: PLANTING DATE JULY 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	17.9126	8.9563		
REP.WPLOT stratum					
CULTIVAR	4	25.0208	6.2552	4.30	0.038
Residual	8	11.6272	1.4534	1.72	
REP.SPLOT stratum					
GRSTAGE	4	197.6349	49.4087	14.60	<.001
Residual	8	27.0799	3.3850	4.00	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	16	137.3073	8.5817	10.13	<.001
Residual	32	27.1095	0.8472		
Total	74	443.6921			

Tables of means
============
Variate: Yield

Grand mean 2.920

CULTIVAR	1	2	3	4	5
	3.306	2.642	2.373	3.863	2.417

GRSTAGE	1	2	3	4	5
	0.960	4.284	0.906	4.317	4.132

CULTIVAR	GRSTAGE 1	2	3	4	5
1	0.810	3.688	0.693	7.499	3.837
2	1.060	4.112	1.095	1.214	5.728
3	0.993	4.508	0.790	1.461	4.110
4	1.185	5.472	0.880	8.555	3.224
5	0.754	3.638	1.075	2.857	3.762

Standard errors of means

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
e.s.e.	0.3113	0.4750	0.7014
d.f.	8	8	28.69

Except when comparing means with the same level(s) of

CULTIVAR	0.6720
d.f.	25.62
GRSTAGE	0.5682
d.f.	37.64

Least significant differences of means (5% level)

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
l.s.d.	1.0151	1.5492	2.0297
d.f.	8	8	28.69
Except when comparing means with the same level(s) of			
CULTIVAR		1.9549	
d.f.		25.62	
GRSTAGE		1.6271	
d.f.		37.64	

Stratum standard errors and coefficients of variation
==

Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.5985	20.5
REP.WPLOT	8	0.5391	18.5
REP.SPLOT	8	0.8228	28.2
REP.WPLOT.SPLOT	32	0.9204	31.5

APPENDIX A.5

STATISTICAL ANALYSIS DEWAGENINGS DRIFT: PLANTING DATE AUGUST 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	7.185	3.592		
REP.WPLOT stratum					
CULTIVAR	4	2.270	0.568	0.15	0.960
Residual	8	31.137	3.892	1.65	
REP.SPLOT stratum					
GRSTAGE	4	84.232	21.058	4.19	0.040
Residual	8	40.242	5.030	2.13	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	16	8.029	0.502	0.21	0.999
Residual	32	75.488	2.359		
Total	74	248.583			

Tables of means
============

Variate: Yield

Grand mean 2.672

CULTIVAR	1	2	3	4	5
	2.726	2.893	2.654	2.726	2.362

GRSTAGE	1	2	3	4	5
	2.321	2.531	2.970	1.132	4.408

CULTIVAR	GRSTAGE 1	2	3	4	5
1	2.464	2.511	2.724	1.418	4.515
2	2.528	2.539	2.844	1.515	5.039
3	2.418	2.594	3.286	0.795	4.179
4	2.178	3.310	2.581	0.944	4.617
5	2.017	1.699	3.414	0.990	3.689

Standard errors of means

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
e.s.e.	0.5094	0.5791	1.0328
d.f.	8	8	38.66

Except when comparing means with the same level(s) of

CULTIVAR	0.9820
d.f.	35.20
GRSTAGE	0.9426
d.f.	37.99

Least significant differences of means (5% level)

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	15	15	3
l.s.d.	1.6612	1.8885	2.9551
d.f.	8	8	38.66

Except when comparing means with the same level(s) of

CULTIVAR	2.8189
d.f.	35.20
GRSTAGE	2.6987
d.f.	37.99

Stratum standard errors and coefficients of variation
======================================
Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.3791	14.2
REP.WPLOT	8	0.8823	33.0
REP.SPLOT	8	1.0030	37.5
REP.WPLOT.SPLOT	32	1.5359	57.5

APPENDIX A.6

STATISTICAL ANALYSIS DEWAGENINGS DRIFT: PLANTING DATE SEPTEMBER 2007

Variate: Yield

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	2	0.01245	0.00622		
REP.WPLOT stratum					
CULTIVAR	4	0.67570	0.16892	1.09	0.423
Residual	8	1.24065	0.15508	1.64	
REP.SPLOT stratum					
GRSTAGE	1	5.74306	5.74306	193.85	0.005
Residual	2	0.05925	0.02963	0.31	
REP.WPLOT.SPLOT stratum					
CULTIVAR.GRSTAGE	4	0.17131	0.04283	0.45	0.768
Residual	8	0.75613	0.09452		
Total	29	8.65855			

Tables of means
============

Variate: Yield
Grand mean 1.154

CULTIVAR	1	2	3	4	5
	1.236	1.193	1.092	1.346	0.902

GRSTAGE	1	2
	0.716	1.591

CULTIVAR GRSTAGE	1	2
1	0.696	1.776
2	0.724	1.662
3	0.753	1.431
4	0.984	1.708
5	0.424	1.380

Standard errors of means

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	6	15	3
e.s.e.	0.1608	0.0444	0.1931
d.f.	8	2	14.38

Except when comparing means with the same level(s) of

CULTIVAR	0.1649
d.f.	9.08
GRSTAGE	0.2040
d.f.	15.11

Least significant differences of means (5% level)

Table	CULTIVAR	GRSTAGE	CULTIVAR GRSTAGE
rep.	6	15	3
l.s.d.	0.5243	0.2704	0.5842
d.f.	8	2	14.38
Except when comparing means with the same level(s) of			
CULTIVAR		0.5267	
d.f.		9.08	
GRSTAGE		0.6144	
d.f.		15.11	

Stratum standard errors and coefficients of variation
======================================

Variate: Yield

Stratum	d.f.	s.e.	cv%
REP	2	0.0249	2.2
REP.WPLOT	8	0.2785	24.1
REP.SPLOT	2	0.0770	6.7
REP.WPLOT.SPLOT	8	0.3074	26.6

APPENDIX B1

STATISTICAL ANALYSES NOOITGEDACHT: PLANTING DATE FEBRUARY 2007, FIRST CUT.

Variate: Yield[1]

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	1.7894	0.3579	1.82	
REP.PLOT stratum					
CULTIVAR	4	13.0353	3.2588	16.57	<.001
Residual	20	3.9330	0.1966		
Total	29	18.7577			

Tables of means
============

Variate: Yield[1]
Grand mean 0.8766

CULTIVAR	1	2	3	4	5
	0.2452	0.6828	1.9364	1.3002	0.2181

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	20
e.s.e.	0.18104

Least significant differences of means (5% level)

Table	CULTIVAR
rep.	6
d.f.	20
l.s.d.	0.53406

Stratum standard errors and coefficients of variation
=====================================

Variate: Yield[1]

Stratum	d.f.	s.e.	cv%
REP	5	0.26754	30.5
REP.PLOT	20	0.44345	50.6

Experimentwise error rate = 0.0500
F value is 16.57 on 4 and 20 degrees of freedom
Overall F test is significant, pairwise testing proceeds.

Identifier	Mean
3	1.9364 a
4	1.3002 b
2	0.6828 c
1	0.2452 c
5	0.2181 c

APPENDIX B2

STATISTICAL ANALYSES NOOITGEDACHT: PLANTING DATE FEBRUARY 2007, SECOND CUT.

Variate: Yield[2]

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	0.23701	0.04740	2.05	
REP.PLOT stratum					
CULTIVAR	4	1.00934	0.25233	10.89	<.001
Residual	19	0.44012	0.02316		
Total	28	1.67775			

Tables of means
===========

Variate: Yield[2]
Grand mean 0.4555

CULTIVAR	1	2	3	4	5
	0.2772	0.1960	0.6247	0.6366	0.5429

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	19
e.s.e.	0.06213

(Not adjusted for missing values)

Least significant differences of means (5% level)

Table	CULTIVAR
rep.	6
d.f.	19
l.s.d.	0.18392

(Not adjusted for missing values)

Stratum standard errors and coefficients of variation
=====================================

Variate: Yield[2]

Stratum	d.f.	s.e.	cv%
REP	5	0.09737	21.4
REP.PLOT	19	0.15220	33.4

All pairwise comparisons are tested.

Fisher's Protected Least Significant Difference test

Experimentwise error rate = 0.0500
F value is 10.89 on 4 and 19 degrees of freedom
Overall F test is significant, pairwise testing proceeds.

Identifier	Mean
4	0.6366 a
3	0.6247 a
5	0.5429 a
1	0.2772 b
2	0.1960 b

APPENDIX B3

STATISTICAL ANALYSES NOOITGEDACHT: PLANTING DATE FEBRUARY 2007, THIRD CUT.

Variate: Yield[3]

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	4.6142	0.9228	3.99	
REP.PLOT stratum					
CULTIVAR	4	29.2250	7.3062	31.60	<.001
Residual	20	4.6237	0.2312		
Total	29	38.4629			

Tables of means
===========
Variate: Yield[3]

Grand mean 5.0924

CULTIVAR	1	2	3	4	5
	4.7731	3.4788	5.1445	6.4766	5.5888

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	20
e.s.e.	0.19629

Least significant differences of means (5% level)

Table	CULTIVAR
rep.	6
d.f.	20
l.s.d.	0.57907

Stratum standard errors and coefficients of variation
======================================

Variate: Yield[3]

Stratum	d.f.	s.e.	cv%
REP	5	0.42961	8.4
REP.PLOT	20	0.48082	9.4

Al pairwise comparisons are tested.

Fisher's Protected Least Significant Difference test

Experimentwise error rate = 0.0500
F value is 31.60 on 4 and 20 degrees of freedom
Overall F test is significant, pairwise testing proceeds.

Identifier	Mean
4	6.477 a
5	5.589 b
3	5.145 bc
1	4.773 c
2	3.479 d

APPENDIX B4

STATISTICAL ANALYSES NOOITGEDACHT: PLANTING DATE FEBRUARY 2007, FOURTH CUT.

Variate: Yield[4]

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	0.3723	0.0745	0.31	
REP.PLOT stratum					
CULTIVAR	4	2.0262	0.5066	2.08	0.122
Residual	20	4.8770	0.2439		
Total	29	7.2755			

Tables of means
===========

Variate: Yield[4]
Grand mean 0.6504

CULTIVAR	1	2	3	4	5
	0.6242	1.0978	0.6619	0.2872	0.5807

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	20
e.s.e.	0.20160

Stratum standard errors and coefficients of variation
=====================================

Variate: Yield[4]

Stratum	d.f.	s.e.	cv%
REP	5	0.12203	18.8
REP.PLOT	20	0.49381	75.9

APPENDIX B5

STATISTICAL ANALYSES NOOITGEDACHT: PLANTING DATE FEBRUARY 2007, FIFTH CUT.

Variate: Yield[5]

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	0.005917	0.001183	0.42	
REP.PLOT stratum					
CULTIVAR	4	0.990991	0.247748	87.60	<.001
Residual	19	0.053735	0.002828		
Total	28	0.970905			

Tables of means
===========

Variate: Yield[5]
Grand mean 0.1457

CULTIVAR	1	2	3	4	5
	0.3098	0.4187	0.0000	0.0000	0.0000

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	19
e.s.e.	0.02171

Least significant differences of means (5% level)

Table	CULTIVAR
rep.	6
d.f.	19
l.s.d.	0.06426

Stratum standard errors and coefficients of variation
======================================

Variate: Yield[5]

Stratum	d.f.	s.e.	cv%
REP	5	0.01538	10.6
REP.PLOT	19	0.05318	36.5

All pairwise comparisons are tested.

Fisher's Protected Least Significant Difference test

Experimentwise error rate = 0.0500

F value is 87.60 on 4 and 19 degrees of freedom
Overall F test is significant, pairwise testing proceeds.

Identifier	Mean
2	0.4187 a
1	0.3098 b
3	0.0000 c
4	0.0000 c
5	0.0000 c

APPENDIX B 6:
Statistical analysis of the total DM production of the five winter fodder crops on Nooitgedacht.

Analysis of variance

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
REP stratum	5	7.9071	1.5814	2.90	
REP.PLOT stratum					
CULTIVAR	4	40.2077	10.0519	18.43	<.001
Residual	20	10.9100	0.5455		
Total	29	59.0248			

Tables of means

Variate: TotalYld

Grand mean 7.1943

CULTIVAR	1	2	3	4	5
	6.1689	5.8035	8.3677	8.7007	6.9305

Standard errors of means

Table	CULTIVAR
rep.	6
d.f.	20
e.s.e.	0.30152

Least significant differences of means (5% level)

Table	CULTIVAR
rep.	6
d.f.	20
l.s.d.	0.88950

Stratum standard errors and coefficients of variation

Variate: Total Yld

Stratum	d.f.	s.e.	cv%
REP	5	0.56239	7.8
REP.PLOT	20	0.73858	10.3

All pairwise comparisons are tested.
Fisher's Protected Least Significant Difference test

Experiment wise error rate = 0.0500
F value is 18.43 on 4 and 20 degrees of freedom
Overall F test is significant, pairwise testing proceeds.

Identifier	Mean
4	8.701 a
3	8.368 a
5	6.930 b
1	6.169 bc