

# The Production Potential of Italian and Westerwolds Ryegrasses Planted at Different Planting Dates

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**T**he seasonal variation in growth and nutritional value of perennial pastures restrict animal production. The fodder flow program for dairy and beef cattle production units in the coastal region of the Southern Cape of South Africa consist mainly of combinations of perennial pastures such as lucerne (*Medicago sativa*), Kikuyu (*Pennisetum clandestinum*), perennial ryegrass (*Lolium multiflorum*) and clover species (*Trifolium repens* en *T. pratense*).

The growth rates of these crops differ during spring, summer and autumn, but reach a mutual low during winter (Van Heerden *et al.* 1989). In an effort to overcome the problem of pasture shortages during winter, seasonal variation in growth and pasture quality, farmers in the Southern cape plant annual ryegrass (*Lolium multiflorum* spp.) in pure stands, in mixtures with other annual grasses or as crops over-sown into perennial pastures. Data regarding the production potential of annual ryegrass planted at different planting dates is inadequate to assist in accurate fodder flow planning. The aim of this study was to determine the pasture production potential of Italian and Westerwolds ryegrasses planted at different

## Procedures

The study was carried out between 2009 and 2011 on the Outeniqua Research Farm near George (altitude 201 m, 33° 58' 38" S and 22° 25' 16" E, rainfall 729 mm year<sup>-1</sup>) in the Western Cape of South Africa. The area has a temperate climate, with mean minimum and maximum air temperatures varying between 7 °C -15 °C and 18 °C - 25 °C, respectively. The study was a small-plot trial carried out on an Estcourt soil type (Soil Classification Workgroup 1991) under irrigation. The grasses were sown in 150 mm rows at a seeding rate of 20 kg ha<sup>-1</sup> for the diploid and 25 kg ha<sup>-1</sup> for the tetraploid cultivars. Plot size for each cultivar was 10.5 m<sup>2</sup>. Irrigation was applied by means of a permanent overhead sprinkler system in one or two applications per week, at rates of 10-15 mm, based on tensiometer readings. Irrigation commenced at a tensiometer reading of -25 kPa and was terminated at a reading of -10 kPa. Annual ryegrass (*L. multiflorum*) varieties nl. Italicum (Italian ryegrass) and Westerwoldicum (Westerwolds ryegrass) were evaluated. The data of four Italian and four Westerwolds ryegrass cultivars planted in separate plots were pooled and the production rate and total production

calculated. The varieties, ploid and cultivars combined and used as treatments, are given in Table 1. Prior to planting, fertiliser was applied according to the soil analysis to raise soil phosphorous (P) level to 35 mg kg<sup>-1</sup> (citric acid), potassium (K) level to 80 mg kg<sup>-1</sup> and pH (KCl) to 5.5. Nitrogen (N) was applied to the grass and grass-legume pastures at a rate of 50 kg N ha<sup>-1</sup> month<sup>-1</sup>.

All the treatments were planted on 24 consecutive months from May 2009 until April 2011 in a well prepared seedbed. The dry matter (DM) production was estimated by cutting the treatments by means of a sickle bar mower set to a height of 50 mm at an interval of 28-35 days, when the ryegrasses had reached the three leaf stage or when overshadowing of the growing points of grasses had started to occur (Fulkerson & Donaghy 2001). Samples were dried at 60°C for 72 hours to a constant mass and weighed to determine DM content (%) and dry matter (DM) production.

The trial was a randomised complete block design with 184 treatment combinations randomly replicated in two blocks. The treatment design was a factorial with two factors nl. planting dates and cultivars. An appropriate analysis of variance (ANOVA) was performed, using SAS/STAT software, Version 9.2 (SAS, 2008). The Shapiro-Wilk test (Shapiro & Wilk 1965) was performed to test normality of residuals and Student's t-LSD (least significant difference) (Ott 1993) was calculated at a 5% significance level to compare treatment means.

The two treatments evaluated during the trial according to annual ryegrass variety, ploidy and cultivar combinations are given in Table 1.

## Results and discussion

Table 2 shows the monthly growth rate (kg DM ha<sup>-1</sup> day<sup>-1</sup>) and total dry matter production (ton DM ha<sup>-1</sup>) of Italian ryegrass planted at different planting dates.

Italian ryegrass was harvested up to ten times if planted during January, February or March with a total DM production (Table 4) of 9.7, 10.1 and 9.9 ton DM ha<sup>-1</sup> respectively. The total harvests decreased monthly from 7 to 3 harvests if planted from April until September. The total DM production (Table 4) decreased during the same period from 8.7 to 5.5 ton DM ha<sup>-1</sup>. The December planting date was also harvested ten times but the monthly growth rate from June until September and the total DM production (8.5 to DM ha<sup>-1</sup>) were lower ( $P < 0.05$ ) than the January, February and March planting dates for this critical winter period.

If the aim in a fodder flow program is to provide feed from May until November, which include the critical winter months (June, July and August), it is better to plant Italian ryegrass during January, February or March. The production will be spread over nine to ten harvests with growth rates from 13 and 53 kg DM ha<sup>-1</sup> day<sup>-1</sup> and a total production of 9.7 and 10.1 ton DM ha<sup>-1</sup>.

Treatment	Variety	Ploidy	Cultivar
1	Italian	Diploid	Agriton
	Italian	Diploid	Enhancer
	Italian	Tetraploid	Jeanne
	Italian	Tetraploid	Parfait
2	Westerwolds	Diploid	Agri-Hilton
	Westerwolds	Tetraploid	Archie
	Westerwolds	Tetraploid	Energa
	Westerwolds	Tetraploid	Jivet

**Table 1** The two treatments evaluated during the trial according to annual ryegrass (*L. multiflorum*) variety, ploidy and cultivar combinations.

Plant date	Monthly growth rate (kg DM ha <sup>-1</sup> day)												Feature				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr
Dec	5 <sup>G</sup>	21 <sup>yz-AB</sup>	31 <sup>qrs</sup>	31 <sup>qrs</sup>	38 <sup>m-nop</sup>	24 <sup>wx</sup>	20 <sup>zB</sup>	16 <sup>BC</sup>	45 <sup>ijkl</sup>	52 <sup>fg</sup>							
Jan			14 <sup>C</sup>	21 <sup>yz-AB</sup>	38 <sup>m-nop</sup>	30 <sup>st</sup>	25 <sup>wx</sup>	31 <sup>qrs</sup>	50 <sup>fg</sup>	46 <sup>hijk</sup>	33 <sup>qrs</sup>	23 <sup>xyz</sup>					
Feb				17 <sup>AB</sup>	43 <sup>kl</sup>	36 <sup>op</sup>	27 <sup>uv</sup>	32 <sup>pq</sup>	47 <sup>ghi</sup>	49 <sup>fg</sup>	37 <sup>no</sup>	19 <sup>AB</sup>	21 <sup>yz-AB</sup>				
Mar				13 <sup>C</sup>	37 <sup>op</sup>	35 <sup>op</sup>	33 <sup>qrs</sup>	48 <sup>ghi</sup>	53 <sup>fg</sup>	47 <sup>ghi</sup>	25 <sup>wx</sup>	33 <sup>qrs</sup>	33 <sup>qrs</sup>				
Apr					12 <sup>DE</sup>		38 <sup>m-nop</sup>	66 <sup>d</sup>	55 <sup>ef</sup>	46 <sup>hijk</sup>	26 <sup>vw</sup>	30 <sup>st</sup>	30 <sup>st</sup>				
May							11 <sup>EF</sup>	64 <sup>d</sup>	74 <sup>c</sup>	62 <sup>d</sup>	45 <sup>ijkl</sup>	37 <sup>no</sup>	37 <sup>no</sup>				
Jun								5 <sup>GF</sup>	76 <sup>c</sup>	86 <sup>b</sup>	63 <sup>d</sup>	43 <sup>kl</sup>	43 <sup>kl</sup>				
July									23 <sup>xyz</sup>	92 <sup>a</sup>	75 <sup>c</sup>	51 <sup>fg</sup>	51 <sup>fg</sup>				
Aug										32 <sup>pq</sup>	75 <sup>c</sup>	60 <sup>de</sup>	25 <sup>wx</sup>				
Sep											41 <sup>lm</sup>	77 <sup>c</sup>	45 <sup>kl</sup>				
Oct												27 <sup>tu- vw</sup>	61 <sup>d</sup>	34 <sup>qrs</sup>	11 <sup>EF</sup>	29 <sup>stuv</sup>	29 <sup>stuv</sup>
Nov													29 <sup>stuv</sup>	54 <sup>ef</sup>	10 <sup>EF</sup>	26 <sup>vw</sup>	26 <sup>vw</sup>

Table 2: The monthly growth rate (kg DM ha<sup>-1</sup>day<sup>-1</sup>) of Italian ryegrass planted at different planting dates.

If the aim is to produce optimum spring and early summer (August to December) fodder, Italian ryegrass should be planted during April, May or June. The ryegrass will be productive for 5 to 7 months and the total DM production can vary between 8 and 9 ton DM ha<sup>-1</sup>. However, Italian ryegrass planted from July until November will result in short periods (2-3 months) of high production (up to 92 kg DM ha<sup>-1</sup> day<sup>-1</sup>) but the total DM production over the growth period will be low and can vary between 3.9 and 7.7 ton DM ha<sup>-1</sup>.

Table 3 shows the monthly growth rate (kg DM ha<sup>-1</sup> day<sup>-1</sup>) of Westerwolds ryegrass planted at different planting dates.

The Westerwolds ryegrass was harvested nine times if planted during January and eight times if planted during February or March with a total DM production of 7.0, 8.3 and 7.8 ton DM ha<sup>-1</sup>, respectively. The amount of harvests decreased monthly from 6 to 3 harvests if planted from April until September. The total DM production (Table 4) varied between 7.0 and 8.3 ton DM ha<sup>-1</sup> when planted during January and February respectively but could be as low as 3.7 and 4.1 ton DM ha<sup>-1</sup> if planted during October or November.

The December planting date produced 10 harvests but although the March, April and May growth rates were similar ( $P>0.05$ ), they were higher ( $P<0.05$ ) than the June, July and August planting dates. The total DM production (Table 4) of the December planting date (7.6 ton DM ha<sup>-1</sup>) was also higher ( $P<0.05$ ) than the total DM production (ton DM ha<sup>-1</sup>) of the April, September, October and November planting dates but

similar ( $P>0.05$ ) to that of the other planting dates. If planted during December it can be expected that Westerwold ryegrass, as a pasture, will not be productive from November onwards. This will have an adverse effect on the fodder flow program since this data also shows that the September until November planting dates are the worst period to establish Italian or Westerwolds ryegrass and feed shortages can be expected.

If the aim is to plant Westerwolds ryegrass as fodder from May until November, which include the winter months (June, July and August), it is better to plant Westerwolds ryegrass during January, February or March. The production will be spread over 8-9 harvests, varied between 15 and 46 kg DM ha<sup>-1</sup> day<sup>-1</sup> and a total DM production (Table 4) of between 7.0 and 8.3 ton DM ha<sup>-1</sup>. If the aim is to produce optimum spring (September until November) and early summer (December) fodder from Westerwolds ryegrass, it is better to plant during May and June for spring and July or August for early summer production. The ryegrass will be productive between 3 and 6 months and the total DM production (Table 4) will vary between 3.7 and 7.6 ton DM ha<sup>-1</sup>. Westerwolds ryegrass planted from August until November will only be productive for short periods (mostly 2 – 4 months) producing up to 68 kg DM ha<sup>-1</sup> day<sup>-1</sup> but the total production will be low and can vary between 3.7 and 6 ton DM ha<sup>-1</sup>. Table 4 compares the total DM production (ton DM ha<sup>-1</sup>) of Italian and Westerwolds ryegrass planted at different planting dates.

Plant date	Monthly growth rate (kg DM ha <sup>-1</sup> day)												Feature		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb
Dec	7 <sup>H</sup>	21 <sup>AB</sup> CDE	32 <sup>qrs</sup> tuv	29 <sup>stu-</sup> vwxyz	32 <sup>qrst</sup> uvw	20 <sup>ABC</sup> DE	16 <sup>DEFG</sup>	12 <sup>GH</sup>	44 <sup>hij</sup>	35 <sup>m-</sup> nopqrs					
Jan			15 <sup>FG</sup>	19 <sup>BCDE</sup> FG	32 <sup>pqrs</sup> tu	25 <sup>vwxy</sup> zAB	21 <sup>ABCD</sup> E	25 <sup>xyzAB</sup>	41 <sup>hijkl</sup> mn	25 <sup>wxyz-</sup> AB	16 <sup>DEFG</sup>				
Feb				25 <sup>xyz-</sup> AB	43 <sup>hijkl</sup>	31 <sup>qrstu-</sup> vwX	26 <sup>wxyz</sup> A	29 <sup>stu-</sup> vwxyz	46 <sup>hi</sup>	30 <sup>qrstu-</sup> vwxy	24 <sup>yzAB</sup>				
Mar				17 <sup>CDEF</sup> G	41 <sup>hijkl</sup> m	34 <sup>opqrs</sup>	31 <sup>qrstu-</sup> vwX	36 <sup>lm-</sup> nopqr	40 <sup>ijklm</sup> no	32 <sup>pqrst</sup>	19 <sup>BCDE</sup> FG				
Apr					15 <sup>FG</sup>		42 <sup>hijklm</sup>	58 <sup>def</sup>	39 <sup>klm-</sup> nop	29 <sup>stu-</sup> vwxyz	21 <sup>ABC</sup> D				
May							13 <sup>GH</sup>	64 <sup>cde</sup>	58 <sup>ef</sup>	44 <sup>hijk</sup>	37 <sup>klmn</sup> opq	8 <sup>zAB</sup> C			
Jun								5 <sup>J</sup>	82 <sup>ab</sup>	76 <sup>b</sup>	42 <sup>hijklm</sup> AB	24 <sup>xyz</sup> AB			
July									22 <sup>AB</sup> CD	86 <sup>a</sup>	59 <sup>def</sup>	53 <sup>fg</sup>			
Aug										33 <sup>pqrst</sup>	68 <sup>c</sup>	47 <sup>gh</sup> zAB	26 <sup>uvwxy</sup> zAB		
Sep											35 <sup>nopq</sup> rs	66 <sup>c</sup>	29 <sup>stuvwX</sup> yz		
Oct												25 <sup>xyz</sup> AB	54 <sup>fg</sup>	26 <sup>tu-</sup> vwxyz	7 <sup>HI</sup>
Nov													43 <sup>hijkl</sup>	65 <sup>cd</sup> A	7 <sup>HI</sup>

Table 3 The monthly growth rate (kg DM ha<sup>-1</sup>day<sup>-1</sup>) of Westerwolds

Ryegrass variety	Planting date and total DM production (ton DM ha <sup>-1</sup> )											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Italian	8.5 cde	9. 7 <sup>a</sup>	10.1 a	9.9 <sup>a</sup>	8.7 <sup>c</sup>	9.0 <sup>b</sup>	8.2 <sup>d</sup>	7.7 <sup>f</sup>	6.6 <sup>ij</sup>	5.5 <sup>jk</sup>	5.2 <sup>l</sup>	3.9 <sup>n</sup>
Westerwolds	7.6 fgh	7. 0 <sup>hi</sup>	8.3 <sup>d</sup> ef	7.8 <sup>e</sup> fg	6.7 <sup>ij</sup>	7.6 <sup>g</sup> h	7.0 <sup>hi</sup>	7.0 <sup>hi</sup>	6.0 <sup>jk</sup>	4.5 <sup>m</sup> n	3.7 <sup>n</sup>	4.1 <sup>n</sup>

Table 4 The total DM production (ton ha<sup>-1</sup>) of Italian and Westerwolds ryegrass planted at different planting dates.

The total DM production (ton DM ha<sup>-1</sup>) of the Italian ryegrass for the December until June planting dates was higher ( $P < 0.05$ ) than that of the Westerwolds ryegrass. The total DM production of both the Italian and Westerwolds ryegrasses during the August, September and November planting dates were low and the difference in DM production between the two varieties were less than 1 ton DM ha<sup>-1</sup>. This data shows that Italian ryegrasses are on a total DM production basis, when planted between December and June, more productive than Westerwold ryegrass. The best plantings dates, depending on the requirements within the fodder flow program, are between December and July.

### **Conclusions**

Planting date influenced the production potential of both Italian and Westerwolds ryegrasses. The combined average growth rate over two years of the two varieties shows that Italian ryegrass, planted from December until June, is more productive than Westerwolds ryegrasses.

The variation in growth rate during spring and early summer over years at similar planting dates is an indication that climatic factors and the presence of weeds can influence the production potential of these temperate grasses. This can be a risk for farmers and an important reason for selecting planting dates in such a way to insure that these crops are productive, have the potential to overcome climatic changes and the ability to compete with spring and summer weeds.

If the aim, from a fodder flow perspective, is to provide fodder from May until November, which also includes the critical winter months (June, July and August), Italian ryegrass, is a better option than Westerwolds ryegrass if planted during February or March. If the aim is to produce optimum spring and early summer (September to December) fodder, Italian ryegrass should be planted during May or June.

Italian or Westerwolds ryegrasses should not be planted later than June. This will result in short productive periods (3-4 months) and the total production will be low.

### **Comments**

Planting date has a pronounced effect on the production potential of Italian and Westerwolds ryegrass. Both these species should be planted at specific planting dates to provide feed within a fodder flow programme from May until November. The production potential of Italian or Westerwolds ryegrass planted from September until November is low and will probably not be cost effective under irrigation if fertilised with nitrogen. December as a planting date for Westerwolds ryegrass is risky and could result in fodder shortage during winter, spring and early summer. If not strategically over-sown into perennial pasture, Italian ryegrass is a better option than Westerwolds ryegrass based on growth rate and total production.



## References

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