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BETTER TOGETHER.

THE SEASONAL AND ANNUAL DRY MATTER PRODUCTION OF FESTULOLIUM HYBRIDS COMPARED TO *FESTUCA* SPP. AND *LOLIUM* SPP. IN THE SOUTHERN CAPE

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Directorate Plant Science, Outeniqua Research Farm 22 September 2015

Selection of appropriate species in pasture systems:

ANIMAL PRODUCTION PER HA

DRY MATTER PRODUCTION

- Fodder flow program = total and seasonal production
- Persistence

HIGH FORAGE QUALITY

- NDF content: 40%
- ADF content: 30%
- Protein content: 23%
- ME content: 10.5 MJ/kg DM

PALATABILITY AND INTAKE

- Ensure high dry matter intake by animals

TOLERANCE TO ADVERSE CONDITIONS

- Remain productive (resistance)
- Recover after (resilience)

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Common pasture species: advantages and challenges

Tall Fescue (*Festuca arundinacea*):

- Tolerance to drought and temperature extremes
- Persistent once established
- Poor palatability and intake by cattle
- Slow to establish compared to ryegrass

Ryegrass (*Lolium* spp.)

- High forage quality
- Palatable, supports high animal production
- Poor persistence in region
- Poor resilience under adverse climatic conditions

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Problem statement

Plant breeders have attempted to combine the high forage quality and palatability of RYEGRASS with stress tolerance of FESCUE = FESTULOLIUM HYBRIDS

1. ***FESTULOLIUM PABULARE LOLOID***
   Tall fescue x Italian ryegrass x Italian ryegrass

2. ***FESTULOLIUM PABULARE FESTUCOID***
   Tall fescue x Italian ryegrass x Tall fescue

3. ***FESTULOLIUM BRUANII LOLOID***
   Meadow fescue x Italian ryegrass x Italian ryegrass

WHAT WOULD BE THE PRODUCTION POTENTIAL RELATIVE TO PARENT SPECIES?

- Establishment
- Persistence
- Seasonal spread of production

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Aim

Determine the monthly growth rate, seasonal dry matter production and total annual dry matter production of *Festulolium* hybrids relative to fescue and ryegrass species

Materials and methods

- Conducted on Outeniqua Research Farm, George, South Africa
- Small plot cutting trial
- Established 11 May 2011 into a cultivated seedbed
- 24 treatments
- 2.1 x 6 m
- Harvested every approximately 28 days/ overshadowing
- Fertilised 50 kg N ha^{-1} after each harvest
- Irrigated according to tensiometers

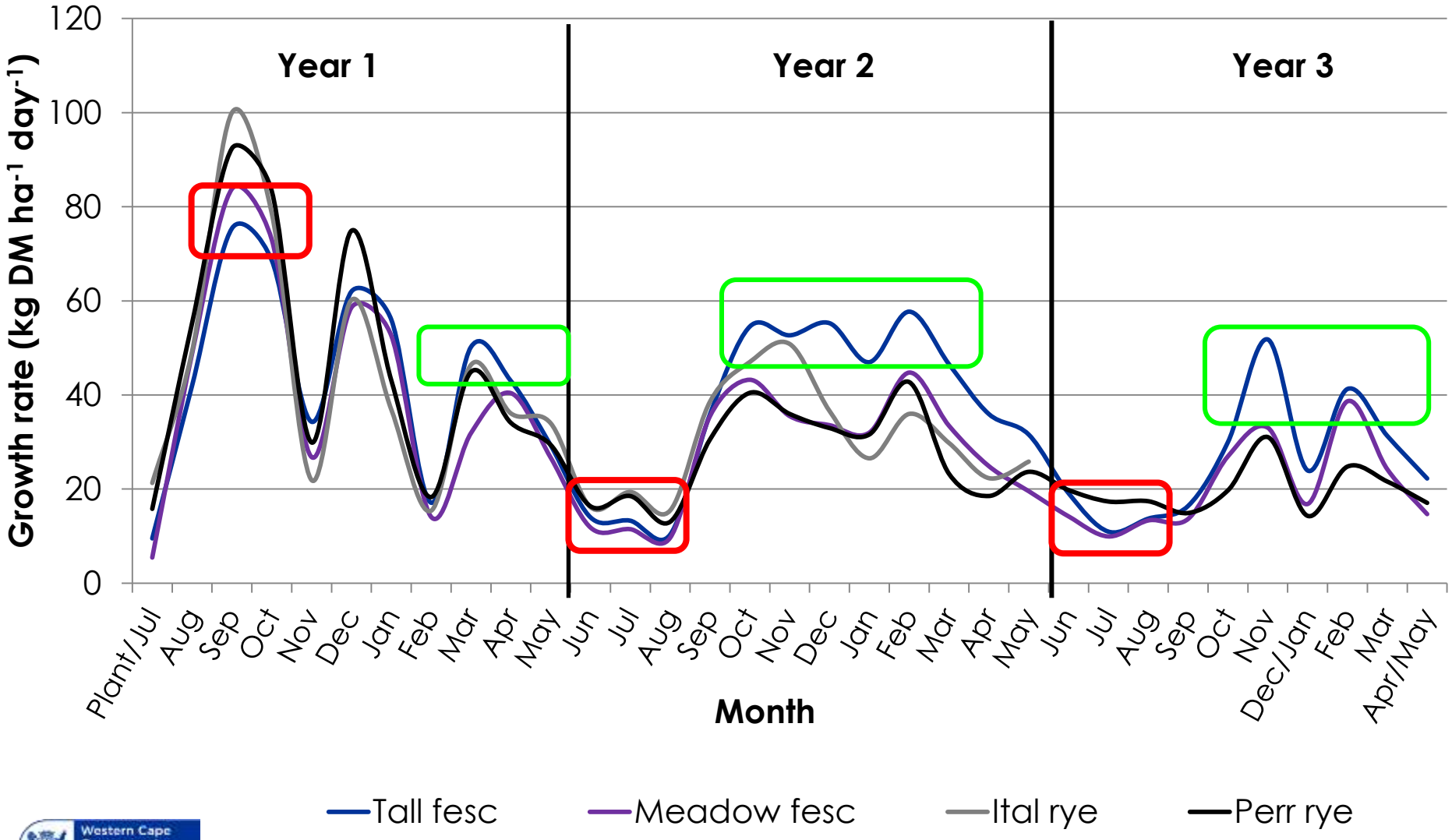
Table 1. Species and cultivar name evaluated

Species	Cultivar	Species	
Tall Fescue	Kora	*Festulolium pabulare* festucoid	Felina
	Tuscany		Hykor
	Baroptima		Mahulena
	Verdant		Rebab
	Jenna		HZFLPC2
Meadow fescue	Laura		Fojtan
	Jamaica	*Festulolium pabulare* loloid	Lofa
Italian ryegrass	Jeanne		Becva
	Parfait	*Festulolium braunii* loloid	Perun
Perennial ryegrass	Bealy		Perseus
	Bronsyn		Hostyn
			Paulita
			Achilles

Results:

- Species averages
- All cultivars

Figure 1. Monthly growth rate (kg DM ha^{-1} day^{-1}) of fescue, ryegrass and festulolium hybrids



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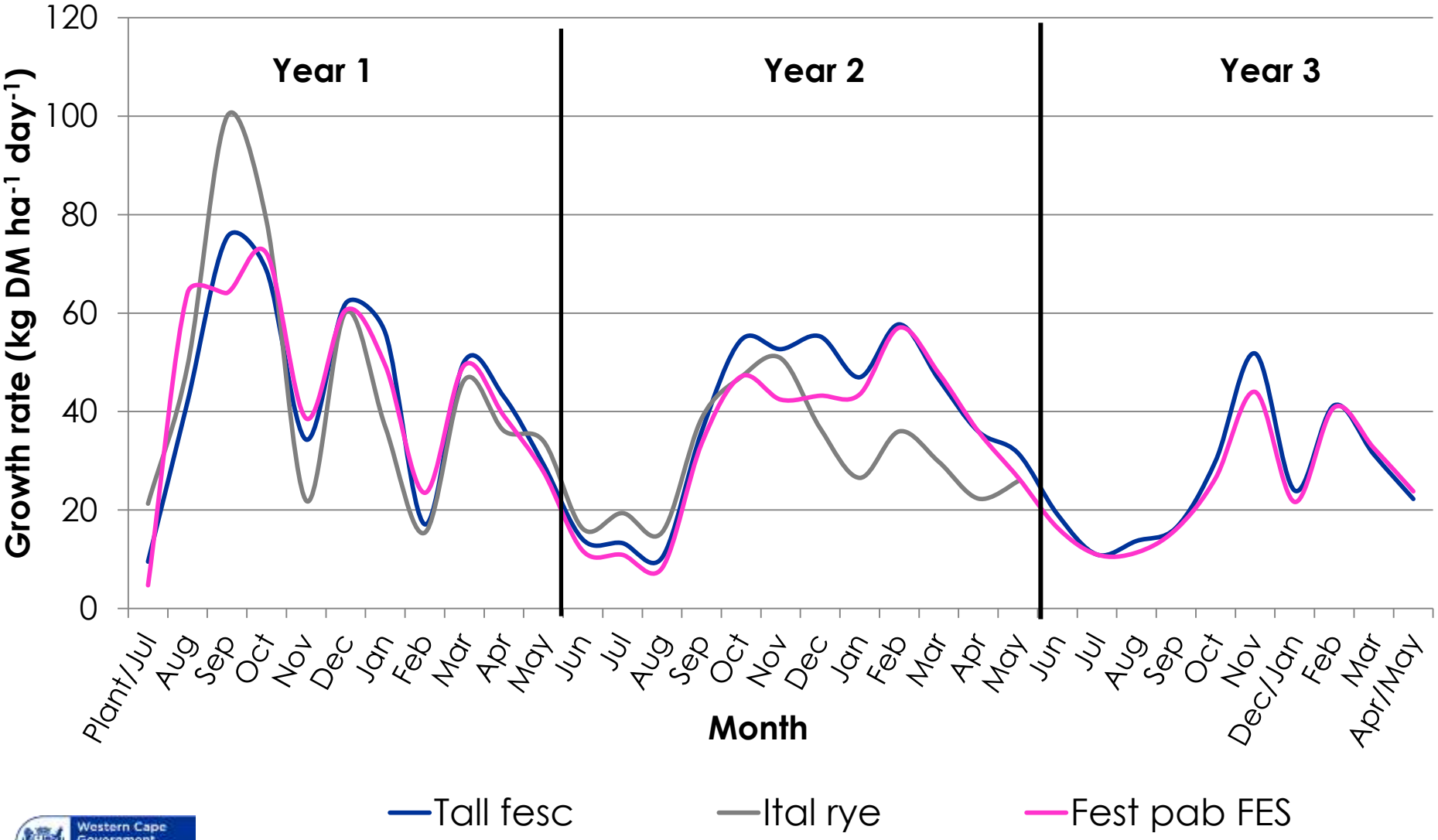

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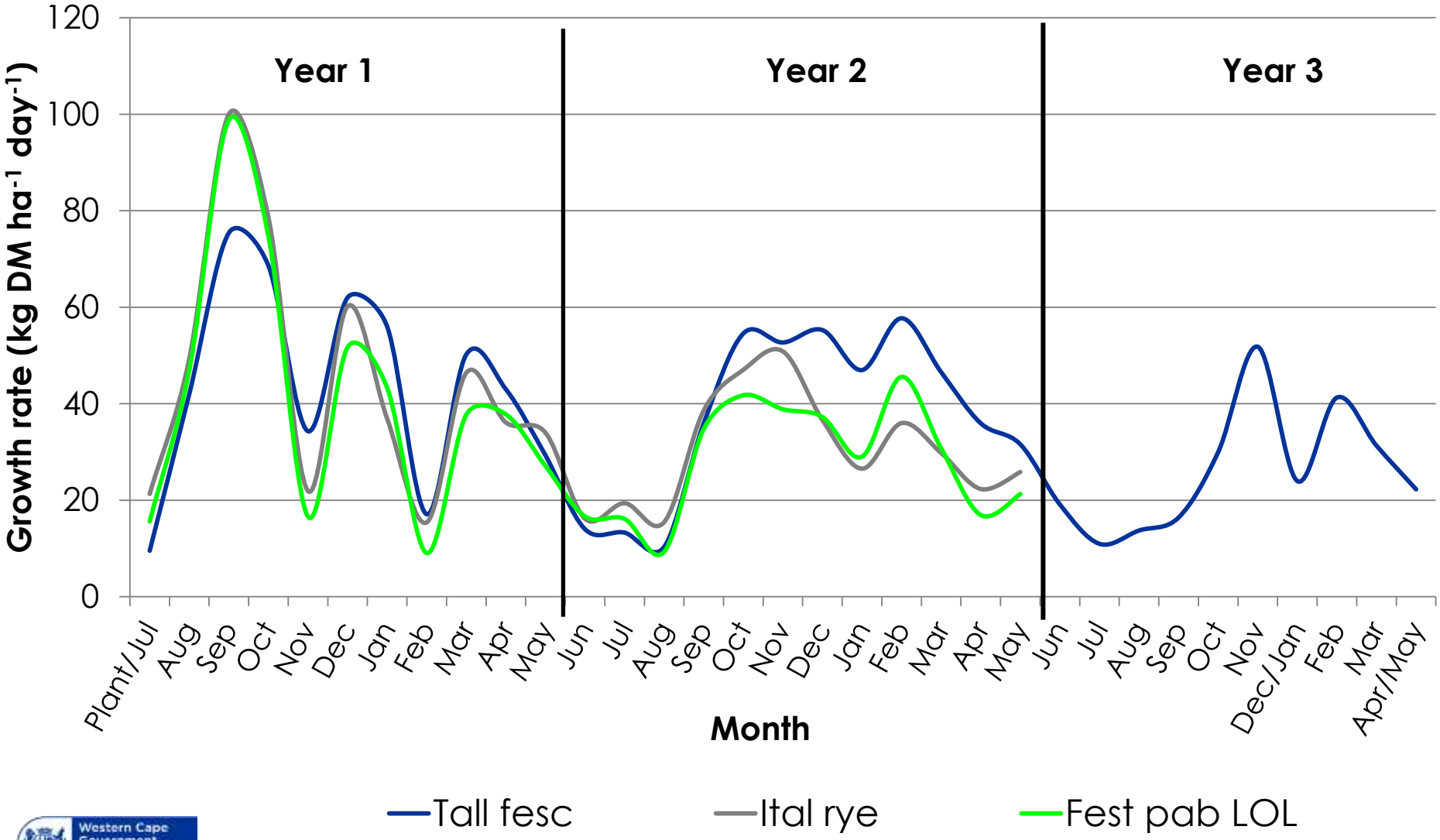

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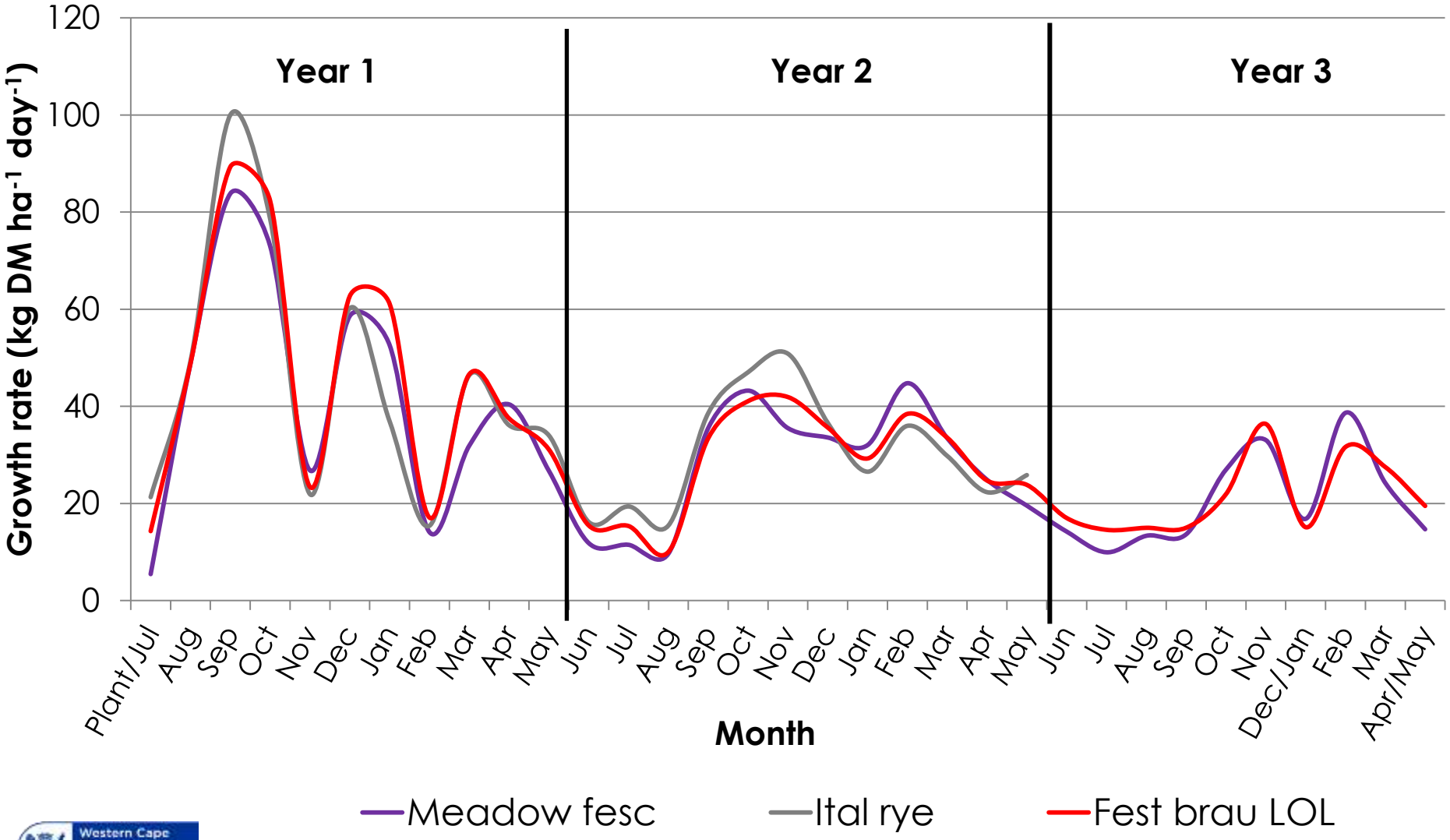

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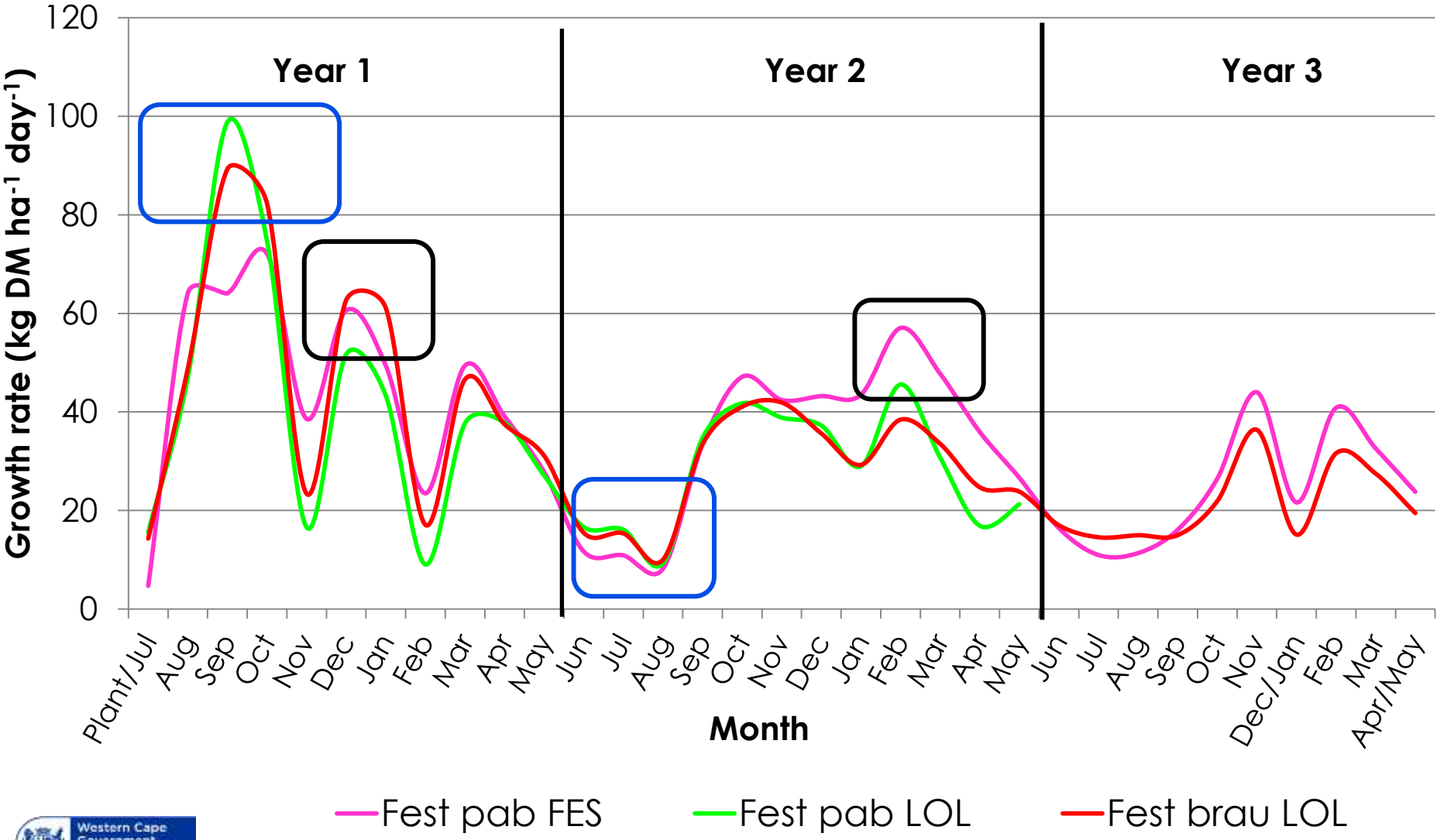

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	Season	Tall Fescue	Meadow fescue	Fest pab Festucoid	Fest pab Loloid	Fest brau Loloid	Perennial ryegrass	Italian ryegrass	LSD
Year 1	Winter	2.41^{cd}	2.19^{de}	1.44^{e}	3.22^{ab}	3.14^{bc}	3.51^{ab}	3.91^{a}	0.762
	Spring	4.97^{cd}	5.12^{bcd}	4.85^{d}	5.44^{abc}	5.33^{abcd}	5.74^{a}	5.62^{ab}	0.510
	Summer	3.85^{ab}	3.57^{abc}	4.13^{a}	2.97^{d}	3.43^{bcd}	3.89^{ab}	3.21^{cd}	0.582
	Autumn	3.44^{a}	2.76^{c}	3.27^{ab}	2.87^{bc}	3.24^{ab}	3.05^{abc}	3.25^{ab}	0.437
Year 2	Winter	1.06^{cd}	0.93^{cd}	0.87^{d}	1.18^{abc}	1.15^{bc}	1.35^{ab}	1.44^{a}	0.275
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	Summer	3.02^{a}	2.43^{b}	2.84^{a}		2.09^{bc}	1.81^{c}		0.382
	Autumn	2.13^{ab}	1.53^{c}	2.24^{a}		1.88^{b}	1.55^{c}		0.322

Table 2. Total seasonal DM production (t DM ha^{-1}) of fescue, ryegrass and festulolium hybrids

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	Summer	3.85^{ab}	3.57^{abc}	**4.13^{a}**	2.97^{d}	3.43^{bcd}	3.89^{ab}	3.21^{cd}	0.582
	Autumn	**3.44^{a}**	2.76^{c}	3.27^{ab}	2.87^{bc}	3.24^{ab}	3.05^{abc}	3.25^{ab}	0.437
Year 2	Winter	1.06^{cd}	0.93^{cd}	0.87^{d}	1.18^{abc}	1.15^{bc}	1.35^{ab}	**1.44^{a}**	0.275
	Spring	**4.49^{a}**	3.59^{bc}	3.86^{abc}	3.63^{bc}	3.67^{bc}	3.36^{c}	4.31^{ab}	0.754
	Summer	**4.54^{a}**	3.14^{b}	4.08^{a}	3.19^{b}	2.94^{b}	3.05^{b}	2.82^{b}	0.592
	Autumn	**3.20^{a}**	2.19^{bc}	3.10^{a}	1.93^{bc}	2.30^{b}	1.83^{c}	2.18^{bc}	0.379
Year 3	Winter	1.43^{bc}	1.20^{d}	1.23^{cd}		1.50^{b}	**1.76^{a}**		
	Spring	**3.18^{a}**	2.37^{bc}	2.79^{ab}		2.36^{bc}	2.10^{c}		0.508
	Summer	**3.02^{a}**	2.43^{b}	**2.84^{a}**		2.09^{bc}	1.81^{c}		0.382
	Autumn	2.13^{ab}	1.53^{c}	**2.24^{a}**		1.88^{b}	1.55^{c}		0.322

Figure 2. Monthly growth rate (kg DM ha^{-1} day^{-1}) of fescue, ryegrass and festulolium hybrids

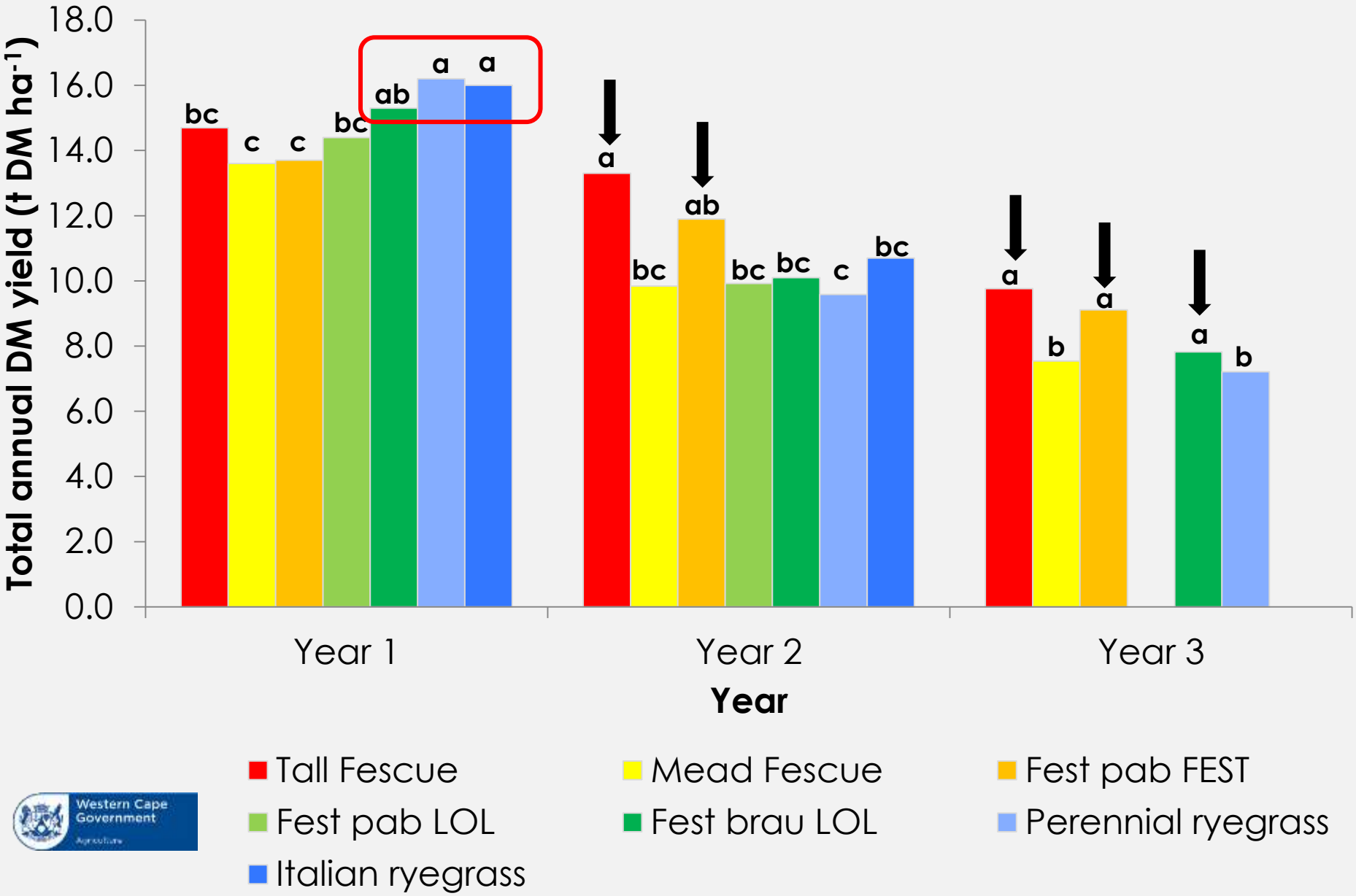

Table 3. Total seasonal and annual dry matter production (t DM ha^{-1}) of fescue, ryegrass and festulolium cultivars during year 1

Species	Cultivar	Winter	Spring	Summer	Autumn	Annual
Tall Fescue	Kora	1.93^{ijk}	5.67^{ab}	3.49^{bcdef}	3.55^{abc}	**14.6^{defghi}**
	Tuscany	1.40^{kl}	4.80^{cd}	4.02^{abcd}	3.27^{abcde}	**13.5^{hij}**
	Baroptima	1.63^{jkl}	4.94^{bcd}	3.76^{bcdef}	3.31^{abcd}	**13.6^{hij}**
	Verdant	**4.72^{a}**	4.36^{d}	3.99^{abcd}	3.63^{ab}	**16.7^{ab}**
	Jenna	2.35^{fghij}	5.05^{abcd}	3.96^{abcde}	3.42^{abc}	**14.8^{cdefgh}**
Meadow Fescue	Laura	2.39^{fghi}	4.82^{cd}	3.50^{bcdef}	2.61^{ef}	**13.3^{hij}**
	Jamaica	2.00^{ghijk}	5.43^{abc}	3.63^{bcdef}	2.92^{cdef}	**14.0^{ghi}**
Fest pab. FESTUCOID	Felina	0.96^{l}	4.31^{d}	4.00^{abcd}	2.91^{cdef}	**12.2^{j}**
	Hykor	1.96^{hijk}	4.93^{bcd}	3.89^{abcde}	3.25^{abcde}	**14.0^{fghi}**
	Mahulena	1.51^{kl}	5.24^{abc}	4.31^{ab}	3.43^{abc}	**14.5^{defghi}**
	Rebab	1.25^{kl}	4.79^{cd}	4.21^{abc}	3.53^{abc}	**13.8^{hij}**
	HZ	1.43^{kl}	4.92^{bcd}	4.32^{ab}	3.12^{abcdef}	**13.8^{hij}**
	Fojtan	1.55^{kl}	4.90^{bcd}	4.04^{abcd}	3.36^{abc}	**13.9^{hi}**
Fest pab LOLOID	Lofa	2.74^{efg}	5.12^{abcd}	2.58^{g}	2.68^{def}	**13.1^{ij}**
	Becva	3.69^{bcd}	5.54^{abc}	3.35^{cdefg}	3.06^{abcdef}	**15.6^{bcdef}**
Fest braunii LOLOID	Perun	3.77^{bc}	5.69^{ab}	2.98^{fg}	3.40^{abc}	**15.8^{bcde}**
	Perseus	2.69^{efgh}	5.46^{abc}	3.23^{defg}	3.03^{abcdef}	**14.4^{efghi}**
	Hostyn	3.28^{bcde}	5.36^{bc}	3.93^{abcde}	3.49^{abc}	**16.1^{bcd}**
	Paulita	2.98^{def}	5.49^{abc}	3.80^{abcdef}	3.30^{abcd}	**15.6^{bcdefg}**
	Achilles	2.99^{def}	5.22^{abc}	3.24^{defg}	2.95^{bcdef}	**14.4^{efghi}**
Perennial ryegrass	Bealy	3.93^{b}	5.70^{ab}	**4.69^{a}**	**3.65^{a}**	**18.0^{a}**
	Bronsyn	3.10^{cdef}	**5.78^{a}**	3.09^{efg}	2.45^{f}	**14.4^{efghi}**
Italian ryegrass	Jeanne	3.95^{b}	5.72^{ab}	2.98^{fg}	3.08^{abcdef}	**15.7^{bcde}**
	Parfait	3.86^{b}	5.52^{abc}	3.44^{bcdefg}	3.47^{abc}	**16.3^{bc}**
LSD (0.05)		0.750	0.820	0.899	0.679	**1.63**

Table 4. Total seasonal and annual dry matter production (t DM ha^{-1}) of fescue, ryegrass and festulolium cultivars during year 2

Species	Cultivar	Winter	Spring	Summer	Autumn	Annual
Tall Fescue	Kora	0.86^{efg}	4.21^{abcd}	4.71^{ab}	**3.25^{a}**	**13.0^{abc}**
	Tuscany	0.85^{efg}	4.36^{abc}	4.63^{ab}	**3.14^{a}**	**13.0^{abc}**
	Baroptima	1.25^{abcde}	4.28^{abc}	4.31^{abcd}	**3.31^{a}**	**13.1^{abc}**
	Verdant	1.12^{abcdef}	**5.22^{a}**	**4.84^{a}**	3.12^{ab}	**14.3^{a}**
	Jenna	1.22^{abcde}	4.37^{abc}	4.24^{abcde}	**3.17^{a}**	**13.0^{abc}**
Meadow Fescue	Laura	0.83^{efg}	3.68^{bcde}	3.03^{ghi}	2.05^{efghi}	**9.59^{defgh}**
	Jamaica	1.03^{cdefg}	3.50^{bcde}	3.24^{fghi}	2.32^{defgh}	**10.1^{defgh}**
Fest pab. FESTUCOID	Felina	0.64^{g}	3.63^{bcde}	4.04^{abcdef}	3.08^{ab}	**11.4^{bcdef}**
	Hykor	0.77^{fg}	3.81^{bcde}	4.05^{abcdef}	3.02^{abc}	**11.6^{abcde}**
	Mahulena	1.09^{bcdef}	4.27^{abc}	4.53^{abc}	**3.48^{a}**	**13.3^{ab}**
	Rebab	0.95^{efg}	3.95^{bcde}	4.04^{abcdef}	**3.24^{a}**	**12.1^{abcd}**
	HZ	0.87^{efg}	3.65^{bcde}	3.75^{bcdefg}	2.63^{bcd}	**10.5^{bcdefg}**
	Fojtan	0.89^{efg}	3.84^{bcde}	4.08^{abcdef}	**3.14^{a}**	**11.9^{abcd}**
Fest pab LOLOID	Lofa	0.92^{efg}	3.01^{de}	2.88^{ghi}	1.83^{hi}	**8.64^{gh}**
	Becva	1.44^{abc}	4.26^{abcd}	3.48^{defghi}	2.03^{fghi}	**11.2^{bcdefg}**
Fest braunii LOLOID	Perun	1.24^{abcde}	3.96^{abcde}	2.95^{ghi}	2.37^{defg}	**10.5^{cdefg}**
	Perseus	1.06^{bcdefg}	3.15^{cde}	2.68^{hi}	2.30^{defghi}	**9.18^{efgh}**
	Hostyn	1.39^{abcd}	4.19^{abcd}	3.18^{fghi}	2.48^{def}	**11.2^{bcdefg}**
	Paulita	1.05^{bcdefg}	3.76^{bcde}	3.30^{efghi}	2.46^{def}	**10.6^{cdefg}**
	Achilles	1.01^{defg}	3.29^{cde}	2.58^{i}	1.89^{ghi}	**8.77^{fgh}**
Perennial ryegrass	Bealy	**1.53^{a}**	3.87^{bcde}	3.60^{cdefgh}	2.41^{def}	**11.4^{bcdef}**
	Bronsyn	1.17^{abcdef}	2.85^{e}	2.49^{i}	1.24^{j}	**7.76^{h}**
Italian ryegrass	Jeanne	1.41^{abcd}	4.01^{abcde}	2.69^{hi}	1.82^{i}	**9.92^{defgh}**
	Parfait	1.47^{ab}	4.61^{ab}	2.96^{ghi}	2.54^{cde}	**11.6^{bcde}**
LSD (0.05)		0.427	1.258	0.986	0.503	**2.717**

Table 4. Total seasonal and annual dry matter production (t DM ha^{-1}) of fescue, ryegrass and festulolium cultivars during year 2

Species	Cultivar	Winter	Spring	Summer	Autumn	Annual
Tall Fescue	Kora	0.86^{efg}	4.21^{abcd}	4.71^{ab}	**3.25^{a}**	**13.0^{abc}**
	Tuscany	0.85^{efg}	4.36^{abc}	4.63^{ab}	**3.14^{a}**	**13.0^{abc}**
	Baroptima	1.25^{abcde}	4.28^{abc}	4.31^{abcd}	**3.31^{a}**	**13.1^{abc}**
	Verdant	1.12^{abcdef}	**5.22^{a}**	**4.84^{a}**	3.12^{ab}	**14.3^{a}**
	Jenna	1.22^{abcde}	4.37^{abc}	4.24^{abcde}	**3.17^{a}**	**13.0^{abc}**
Meadow Fescue	Laura	0.83^{efg}	3.68^{bcde}	3.03^{ghi}	2.05^{efghi}	**9.59^{defgh}**
	Jamaica	1.03^{cdefg}	3.50^{bcde}	3.24^{fghi}	2.32^{defgh}	**10.1^{defgh}**
Fest pab. FESTUCOID	Felina	0.64^{g}	3.63^{bcde}	4.04^{abcdef}	3.08^{ab}	**11.4^{bcdef}**
	Hykor	0.77^{fg}	3.81^{bcde}	4.05^{abcdef}	3.02^{abc}	**11.6^{abcde}**
	Mahulena	1.09^{bcdef}	4.27^{abc}	4.53^{abc}	**3.48^{a}**	**13.3^{ab}**
	Rebab	0.95^{efg}	3.95^{bcde}	4.04^{abcdef}	**3.24^{a}**	**12.1^{abcd}**
	HZ	0.87^{efg}	3.65^{bcde}	3.75^{bcdefg}	2.63^{bcd}	**10.5^{bcdefg}**
	Fojtan	0.89^{efg}	3.84^{bcde}	4.08^{abcdef}	**3.14^{a}**	**11.9^{abcd}**
Fest pab LOLOID	Lofa	0.92^{efg}	3.01^{de}	2.88^{ghi}	1.83^{hi}	**8.64^{gh}**
	Becva	1.44^{abc}	4.26^{abcd}	3.48^{defghi}	2.03^{fghi}	**11.2^{bcdefg}**
Fest braunii LOLOID	Perun	1.24^{abcde}	3.96^{abcde}	2.95^{ghi}	2.37^{defg}	**10.5^{cdefg}**
	Perseus	1.06^{bcdefg}	3.15^{cde}	2.68^{hi}	2.30^{defghi}	**9.18^{efgh}**
	Hostyn	1.39^{abcd}	4.19^{abcd}	3.18^{fghi}	2.48^{def}	**11.2^{bcdefg}**
	Paulita	1.05^{bcdefg}	3.76^{bcde}	3.30^{efghi}	2.46^{def}	**10.6^{cdefg}**
	Achilles	1.01^{defg}	3.29^{cde}	2.58^{i}	1.89^{ghi}	**8.77^{fgh}**
Perennial ryegrass	Bealy	**1.53^{a}**	3.87^{bcde}	3.60^{cdefgh}	2.41^{def}	**11.4^{bcdef}**
	Bronsyn	1.17^{abcdef}	2.85^{e}	2.49^{i}	1.24^{j}	**7.76^{h}**
Italian ryegrass	Jeanne	1.41^{abcd}	4.01^{abcde}	2.69^{hi}	1.82^{i}	**9.92^{defgh}**
	Parfait	1.47^{ab}	4.61^{ab}	2.96^{ghi}	2.54^{cde}	**11.6^{bcde}**
LSD (0.05)		0.427	1.258	0.986	0.503	**2.717**

Table 5. Total seasonal and annual dry matter production (t DM ha^{-1}) of fescue, ryegrass and festulolium cultivars during year 3

Species	Cultivar	Winter	Spring	Summer	Autumn	Annual
Tall Fescue	Kora	1.39^{bcdef}	3.14^{ab}	3.21^{ab}	2.05^{bcdef}	**9.79^{abc}**
	Tuscany	1.24^{ef}	3.25^{ab}	**3.28^{a}**	2.39^{ab}	**10.2^{ab}**
	Baroptima	1.62^{abcd}	3.19^{ab}	2.66^{bcdef}	2.06^{bcdef}	**9.52^{abcd}**
	Verdant					
	Jenna	1.47^{bcdef}	3.14^{ab}	2.93^{abcd}	2.02^{bcdef}	**9.56^{abcd}**
Meadow Fescue	Laura	1.12^{f}	2.72^{abcdef}	1.99^{ghi}	1.65^{fgh}	**7.48^{efg}**
	Jamaica	1.28^{def}	2.03^{efg}	2.88^{abcde}	1.42^{gh}	**7.61^{efg}**
Fest pab. FESTUCOID	Felina	1.17^{f}	2.79^{abcde}	2.55^{cdefg}	2.07^{bcdef}	**8.57^{bcdef}**
	Hykor	1.31^{def}	3.07^{abc}	3.04^{abc}	2.08^{bcdef}	**9.50^{abcd}**
	Mahulena	1.34^{bcdef}	**3.39^{a}**	3.11^{abc}	**2.72^{a}**	**10.6^{a}**
	Rebab	1.18^{f}	2.75^{abcde}	2.86^{abcde}	2.25^{abcd}	**9.03^{abcde}**
	HZ	1.19^{ef}	2.25^{cdefg}	2.44^{defgh}	2.01^{bcdef}	**7.88^{defg}**
	Fojtan	1.23^{ef}	2.51^{bcdefg}	3.06^{abc}	2.34^{abc}	**9.14^{abcde}**
Fest pab LOLOID	Lofa					
	Becva					
Fest braunii LOLOID	Perun	1.61^{abcd}	2.28^{cdefg}	1.96^{hi}	1.92^{bcdef}	**7.76^{defg}**
	Perseus	1.37^{bcdef}	2.13^{defg}	2.00^{ghi}	1.83^{cdefg}	**7.34^{efg}**
	Hostyn	1.66^{abc}	2.89^{abcd}	2.34^{efgh}	2.20^{bcde}	**9.10^{abcde}**
	Paulita	1.32^{cdef}	1.90^{fg}	2.05^{ghi}	1.74^{defg}	**7.01^{fg}**
	Achilles	1.53^{abcdef}	2.59^{abcdef}	2.08^{gh}	1.72^{efg}	**7.91^{defg}**
Perennial ryegrass	Bealy	**1.83^{a}**	2.46^{bcdefg}	2.13^{fgh}	1.88^{bcdefg}	**8.31^{cdef}**
	Bronsyn	1.68^{ab}	1.74^{g}	1.48^{i}	1.21^{h}	**6.11^{g}**
Italian ryegrass	Jeanne					
	Parfait					
LSD (0.05)		0.347	0.828	0.577	0.512	**1.808**

Table 6. Total annual dry matter production (t DM ha^{-1}) and decline in production over years of fescue, ryegrass and festulolium cultivars during year 3

Species	Cultivar	Year 1	Year 2	Year 3
Tall Fescue	Kora	14.6^{defghi}	13.0^{abc}	9.79^{abc}
	Tuscany	13.5^{hij}	13.0^{abc}	10.2^{ab}
	Baroptima	13.6^{hij}	13.1^{abc}	9.52^{abcd}
	Verdant	16.7^{ab}	14.3^{a}	
	Jenna	14.8^{cdefgh}	13.0^{abc}	9.56^{abcd}
Meadow Fescue	Laura	13.3^{hij}	9.59^{defgh}	7.48^{efg}
	Jamaica	14.0^{ghi}	10.1^{defgh}	7.61^{efg}
Fest pab. FESTUCOID	Felina	12.2^{j}	11.4^{bcdef}	8.57^{bcdef}
	Hykor	14.0^{fghi}	11.6^{abcde}	9.50^{abcd}
	Mahulena	14.5^{defghi}	13.3^{ab}	10.6^{a}
	Rebab	13.8^{hij}	12.1^{abcd}	9.03^{abcde}
	HZ	13.8^{hij}	10.5^{bcdefg}	7.88^{defg}
	Fojtan	13.9^{hi}	11.9^{abcd}	9.14^{abcde}
Fest pab LOLOID	Lofa	13.1^{ij}	8.64^{gh}	
	Becva	15.6^{bcdef}	11.2^{bcdefg}	
Fest braunii LOLOID	Perun	15.8^{bcde}	10.5^{cdefg}	7.76^{defg}
	Perseus	14.4^{efghi}	9.18^{efgh}	7.34^{efg}
	Hostyn	16.1^{bcd}	11.2^{bcdefg}	9.10^{abcde}
	Paulita	15.6^{bcdefg}	10.6^{cdefg}	7.01^{fg}
	Achilles	14.4^{efghi}	8.77^{fgh}	7.91^{defg}
Perennial ryegrass	Bealy	18.0^{a}	11.4^{bcdef}	8.31^{cdef}
	Bronsyn	14.4^{efghi}	7.76^{h}	6.11^{g}
Italian ryegrass	Jeanne	15.7^{bcde}	9.92^{defgh}	
	Parfait	16.3^{bc}	11.6^{bcde}	
LSD (0.05)		1.63	2.717	1.808

Conclusions

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Conclusions

- **LOLOID** types tended to follow same pattern of production as ryegrass
  - high production during establishment
  - high winter production
  - decline in production during year 2
  - some failed to persist into year 3

- **FESTUCOID** type tended to follow same pattern as Tall fescue
  - slower to establish
  high summer production
- higher production during year 2 and year 3





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Conclusions

Further research required to evaluate the forage quality and palatability of the festulolium varieties

Thank you