

Pasture variety evaluation trials – a practical guide

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Introduction

The high turnover of staff in Government research institutions has resulted in a serious decline in the number of experienced researchers and technicians in government. The decline in experienced staff has meant that many field procedures that were once taken for granted are being forgotten by the new generation of young researchers and technicians entering the discipline.

For research to be effective, it is crucial that strict procedures be followed in the design and implementation of the trial. A well-conceived trial with clear research questions, defensible statistical design and thorough statistical analyses of data can still be regarded as useless if the correct field procedures have not been followed in implementing the trial.

These guidelines have been compiled primarily for those working in pasture cultivar evaluation trials, but many of the principles apply to other aspects of veld and pasture research, and to managing research trials in general.

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Site

The site should be identified at least a year in advance, preferably two years in advance. The site should be planted with a cover crop in which stringent weed control is applied for both broad leaved weeds, nutsedge and grass weeds. The cover crop should be varied depending on the weed component to be controlled. In summer a cover crop of teff is suitable in which both broadleaved weeds and nutsedge



**Fertilisation trial
at Kokstad Re-
search Station**

can be controlled. In winter Saia oats (*Avena strigosa*) can be used. Tropical grasses can be controlled. Alternatively grazing vetch or any other legume can be used in which temperate grasses can be sprayed.

The chosen site must be homogenous with regard to soil type. Homogeneity in terms of fertility is also important and can be corrected during the years of cover crops. Soil samples must be taken once a year and deficiencies corrected accordingly. The cover crop can also be inspected and deficient areas visually identified and then sampled and corrected.

During the year of the trial, the site must be soil sampled three months before planting and the necessary applications of lime, phosphorus and potassium done. Trace elements should also be taken into account if necessary e.g. sulphur.

If the pasture to be evaluated is perennial or hybrid ryegrass, or even Italian or Westerwolds ryegrass, then the soil pH must be taken into consideration. This is

especially of importance in KZN where soil acidity is prevalent. The soil analysis recommendation from the soil lab for lime is based on 0% acid saturation, however on a pasture where large amounts of N are applied the acidification process can be very rapid. In this case it is desirable to raise the soil pH (KCl) to 5 if it is lower. This tends to reduce the rate of soil acidification.

The site should be ploughed or ripped and then worked with a disc harrow. The weed seeds are then allowed to germinate. If conditions are too dry some irrigation may be required to promote the germination of the weeds. Once the weeds have reached the two to three-leaf stage they must be sprayed. If the spraying is not possible the soil can be cultivated again with a disc harrow. If there is sufficient time then the same process can be repeated a second time and hence more weeds are eliminated from the field.

The final seedbed preparation can be done with a tine implement with rollers on the back e.g. Kong-

skilde. The final land preparation should be done on the day the trial is planted or the afternoon before.

Seed

Seed of all the varieties to be evaluated in the trial should be obtained at least two to three months before the planting time. Germination tests must be conducted on all seed samples. Two petri dishes of 50 seeds each are sufficient. These are placed in the growth chambers where they must be topped up with distilled water daily (oats and rye are germinated at 20°C for 7 days and ryegrass at 20°C/30°C for 7 days). If the germination is not sufficient, the sowing rate must be adjusted or if the rate is too low, a new seed sample must be requested. Low germination can also mean reduced vigour of the seedling; simply increasing the amount of seed sown in a treatment still results in that variety being disadvantaged compared to other varieties due to lack of vigour.

The seed must be weighed according to the specific sowing rates of the various types, e.g. diploid vs. tetraploid or perennial vs. hybrid.

The packets must be clearly labelled with the names of the varieties. Once the trial has been designed the plot numbers must be written onto the packets, preferably in a different colour.

Trial design

The design will depend on the num-



Figure 1: Layout of replicates relative to the major gradient of change (Slope in this example)

ber of varieties in the trial. Preferably a lattice design should be used but a randomized block is also satisfactory. If the number of varieties is 12 or less then 4 replications are required. With more than 12 varieties 3 replications are sufficient.

The available field size should be determined before the trial design is done and the design made to fit the site i.e. in terms of the arrangement of the replications. The replications should always run across the slope to ensure that the variability within a replication is less than between replications.

The plot size should take into account the size of the mower and also the irrigation system. For example, the system at Cedara is based on 12 meters between sprinklers. Hence a 2m x 6m plot size is ideal. The sprinklers can then always be placed at the junctions of plots, which means they are always in the border area of the plot and never in the middle of a plot. It is then also easier to demarcate the position of the sprinklers using the

wooden pegs demarcating the plots. (see Figure 2)

Field plans/ Trial plot plans

Field plans must be drawn up. These must indicate the list of treatments and how these treatments are allocated to the plots. Letters of the alphabet are used for the treatments. The plan must also contain the plot numbers. **Very importantly, reference points must be shown on the plan** e.g. road, fence, gate to aid with the orientation of the plan. The plan should also indicate the slope (see Annexure A for an example of a field plan)

It is very important to have a number of copies of the field plan before the trial is planted and give a copy to a fellow researcher/ technician to file in case the original copy is lost or mislaid.

Laying out the trial in the field

The trial should always be positioned some distance from the road, e.g. 5m away to avoid fertility or moisture influences from the roadway. To obtain perpendicular corners and square the trial off, an optical square can be used, or the Pythagoras triangle (3, 4, 5) using a tape measure. An optical square is preferable and easier to use.

If an existing trial is in the vicinity, then the new trial should be squared off taking the alignment of existing trials into account if possible. This is also helpful with the irrigation placement.

Once the trial corners have been determined, a peg should be placed at each corner exactly 1m out to allow the shallow furrows to be drawn with a tractor. Some orientation pegs will have to be put in for the tractor driver to aim for while making the furrows.

Once the furrows are made the corner pegs must be put back (1m in). Now all the other pegs can be placed using the tape measure. First along the top and bottom of the long sides and then those can be used to measure out the remaining pegs on the inside of the trial.

Sowing

The seed packets must be put out according to the plot plan and the numbers on the packets. After the packets have been placed in each plot, it is necessary to check every packet once again against the field plan. The seeds are then sown into the plots and raked closed with the back of a rake. If the people sowing the seed are less experienced, it may be necessary to supply two seed packets for each plot and thus avoid all the seed being sown in the first half of the plot only.

Once the sowing has been completed, all the pegs, except the four corner pegs are to be removed. The corner pegs are then moved 1m out and the tractor (small/light) can roll the entire trial area with a Cambridge roller or similar implement. Depending on the soil, it may be necessary to roll several times to

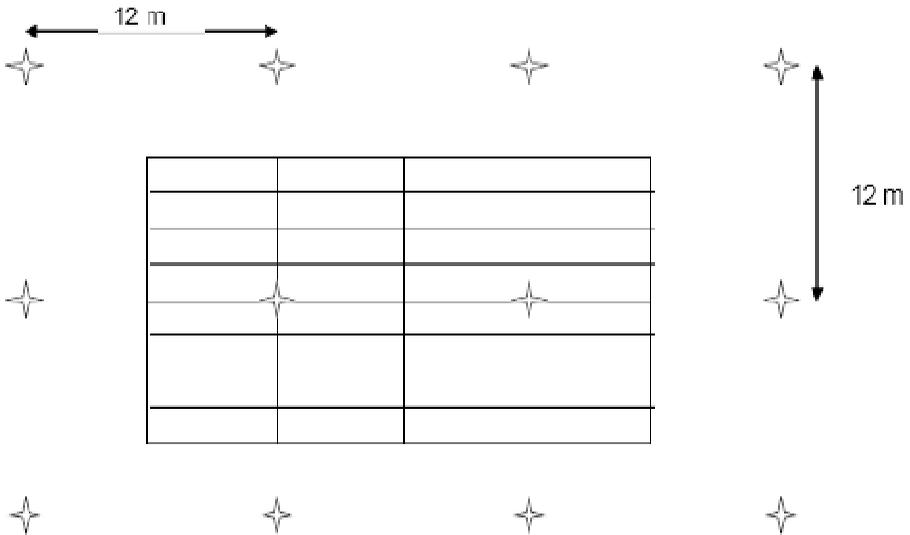


Figure 2: Placement of sprinklers (four-pointed stars) relative to the layout of plots in a small-plot trial

ensure good compaction and hence good contact between the seed and the soil for uniform germination. The pegs can then be moved back and all remaining pegs also replaced. The trial area must then be irrigated if it is an irrigated trial.

Irrigation

The metal irrigation pipes should not run through the trial, as the joins are never watertight and always leak to some degree, resulting in uneven moisture distribution in the trial. The grid placement of the sprinklers should be demarcated with red pegs. The sprinklers should be placed from *outside* the trial area to achieve even water distribution by taking into account over-

lap and wind. Preferably the design should be such that the trial can be irrigated with a minimum number of moves enabling a trial to be irrigated in one day rather than over two days (see Figure 2).

The amount of irrigation water applied should take into account the rainfall and for that reason a rain gauge should be placed in the field of the trial site but away from the irrigation sprinklers.

The irrigation schedule should be as regular as possible and should be adapted according to the rainfall and possibly increased with very hot and dry weather, which could mean applied more frequently.

For irrigated temperate pas-

tures 15 – 25 mm/week is recommended depending on climatic conditions of the season.

Weed control

Weed control is very important, especially in spring planted trials, but also in autumn planted trials. When some plots start showing reduced persistence and the sward opens up allowing weeds in, the necessary

2,4-D	Broad-leaved weeds
Turfweeder	Broad-leaved weeds
Basagran	Nutsedge
Puma Super	Tropical grasses

herbicides should be applied.

Herbicides that are suitable include:

Fertilization

Lime application may be required in some years according to the soil analyses. Zero % acid saturation is especially important for perennial ryegrass and legumes. Preferably the soil pH (KCl) should also be near 5 (Miles pers. comm.¹). The liming recommendations provided by the Fertrec lab at Cedara take the increased pH requirement for perennial ryegrass and legumes into account.

The basal dressings of P and K must be applied before the last site preparation operation and then incorporated into the soil. If lime is

required, it should be incorporated into the soil at least two months before planting. Soon after seedling emergence i.e. approximately 50 mm tall, 50 kg N/ha is applied. Subsequently N and K are applied after each cut to replenish what has been removed with the plant material since there is no return of nutrients through grazing animals. On average the amount of K removed is 3% (Miles pers.comm.) of the weight of dry plant material removed.

Surface liming is required in autumn and spring, especially in perennial ryegrass trials to slow the acidification process resulting from the nitrogen application as well as the natural acidification of the soil in the high rainfall areas of the eastern seaboard (Miles pers. comm.) (1 ton/ha).

The fertilizer must be weighed separately for each plot and each type of fertilizer.

If applications are done with a calibrated fertilizer applicator (drops out the bottom; not suitable for older tufted pastures), then the fertilizer for the entire trial area must be weighed and after application has been completed, any remaining fertilizer must be weighed and hence the exact application rate calculated.

All information regarding fertilization must be recorded on the trial management sheet (see Annexure B).

Data collection

See Annexure B and C for exam-

¹ Dr N Miles, KwaZulu-Natal Department of Agriculture and Environmental Affairs

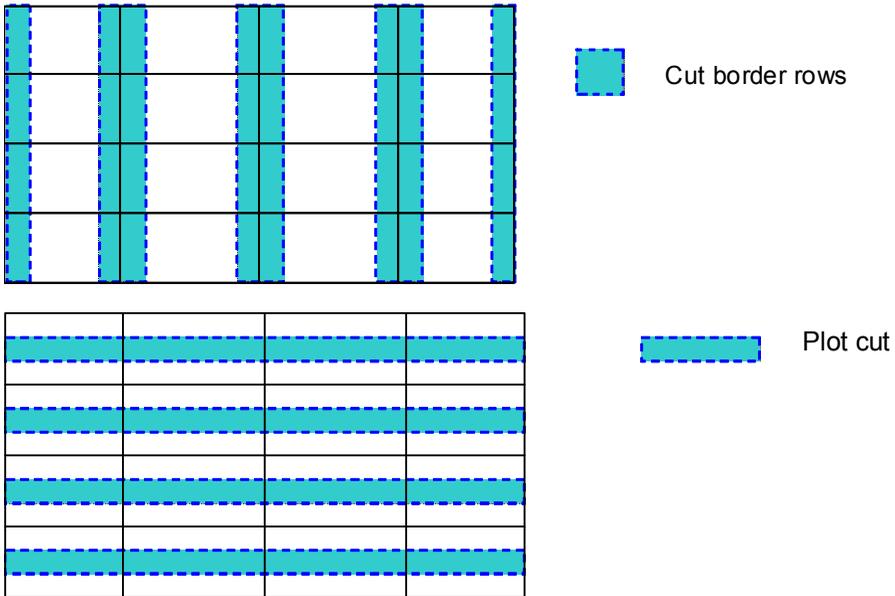


Figure 3: Top: Cut borders between plots first (shaded rectangles , dashed outlines). Bottom: then cut plots (shaded rectangles, dashed outline). The solid lines depict the boundaries of the experimental plots

ples of data sheets and trial management sheets.

Data collection encompasses both the weighed material cut in the plots and the ratings that are done beforehand.

The following ratings are required (on a scale of 1 to 5—see annexure C):

Weeds: are estimated as to their weight contribution to the plot

Rust: if uniform throughout the plot, the severity is rated. If certain plants are more susceptible rating for both severity and incidence in the plot should be given

Cover: this becomes especially important later in the season when persistence differences come to the fore. The cover rating should be done on an area basis in the plot.

Flowering: this should distinguish between piping and heading and give approximately percentages of each. It is sometimes necessary to physically open up the sward and have a look at the plants and determine the height of the growth point by feeling the tillers.

The ratings have to be done before the trial is cut. Preferably the

same person should do the ratings throughout the duration of the trial.

If samples from the trial are to be used for TNC analyses, then it must be cut after 12 noon and the samples should be dried between 70 and 80 °C for at least two full days, *not* counting the day the samples are placed in the oven and taken out.

The border rows across the short sides of the trial are cut out with the mower before the trial is cut. The mower is placed to cut with the peg in the middle of the mower, resulting in half the mower width being removed as border (Figure 3).

Once the trial cutting starts (along the long side of the plot the centre strip (mower width) is cut. Immediately behind the mower the grass in each plot is raked together and a sample for Dry Matter (DM) determination (approx 500g wet weight) taken as quickly as possible into a plastic bag. The bags are immediately sealed with rubber bands to avoid moisture loss. A set of numbered aluminium, cardboard or tough plastic labels is used to number the samples. The set letter is recorded on the data sheet. The labels are placed in the plastic sample packets as the samples are taken from each plot. The person taking the samples should check the label number against the number on the wooden peg. All the grass from the plot together with the sample is placed on a canvass weighing bag and weighed.

Alternatively, if the sample is to

be used for TNC analyses or any other analysis, then it is best to sample ahead of the raking and sample the length of the plot. If weeds are present, the sample should be taken to consist as much as possible of grass only. Additional labels should be supplied for these samples, which can be placed in the milled sample packet.

As soon as all the plots have been cut and weighed, the samples are taken to the oven room. The wet samples are weighed and recorded. The scale has to be zeroed/tared with the plastic packet, the rubber band and the label. The samples are then placed in oven trays with the labels and placed in the drying oven. The placement in the oven should be such that there is movement of air between the trays. The samples are to remain in the oven for two full days not counting the day that they are put in and the day that they are taken out. When the samples are taken out they should be visually inspected and felt to check if they are dry. The oven temperature should also be checked regularly. The oven temperature can be set at 90°C if the samples are not required for analyses afterwards, otherwise 70-80°C if the samples are to be used for herbage analyses. The dry samples are weighed with the scale zeroed with the oven tray and label.

If samples are required for herbage analyses these should be taken to the milling room and milled while the rest of the samples are

thrown away.

The drying ovens should be serviced and checked once a year by a laboratory equipment professional, not only by an electrician.

Data management

The data sheets are best printed on colour paper to avoid excessive glare in the field and can then also be colour coded for species. The data sheets are in duplicate with carbon paper. This allows for the immediate filing of the duplicate copy as the completed raw data sheet arrives back from the oven room. The duplicate copy serves as a very important back-up in case the top copy is lost or accidentally destroyed.

The data are then captured on a computer spreadsheet in a format suitable for the biometricians. Once the data have been captured they must be rigorously checked for typing errors. Small errors in the plot weights or DM weights or even the weed ratings can cause big differences once the yield is converted to a per hectare basis.

The biometricians must be supplied with the field plan. Once the analysed data are returned from the biometricians they must be captured in a suitable table format. This capturing must also be rigorously checked.

For the report to be sent to the funding organisations, the ratings are also included in table format. These are converted to means of

the replications by converting the ratings to percentages and taking the mean. The mean ratings are then grouped into either three or four groups depending on the particular data set (low, medium or high OR very low, low, medium or high). For rust ratings the categories low, moderate or severe are used.

The final data tables should be checked again before being sent out. Hard copies should be filed, as should the top copy of the raw data.

The protocol regarding the handing out of data to the public is as follows:

During the first year after the trial is completed and the data finalised, the information is available to only those organisations who funded varieties in the specific trial. To all other interested parties the data becomes available in the second year after the data has been supplied to the funding companies.

Equipment

The equipment required for evaluations trials is the following:

- Mower
- Drying ovens
- Oven trays
- Electronic scale – hanging
- Electronic scale – table top
- Tarpaulins
- Rakes

The mower requires constant maintenance. The blades should be sharpened regularly and replaced when necessary.

The drying ovens and electronic scales must be serviced once a year to maintain the accuracy of the equipment.

The oven trays and tarpaulins must be checked for weight uniformity once a year.

Annexure A: Example of a field trial layout plan, showing plot numbers, treatments, location and adjacent landmarks

Lolium multiflorum

YT 38

2001

Cedara A2-1

Freeway

N	1	P	2	O	3	M	4
S	8	Q	7	T	6	R	5
G	9	H	10	F	11	E	12
J	16	L	15	I	14	K	13
C	17	B	18	D	19	A	20
J	24	A	23	N	22	R	21
K	25	G	26	C	27	T	28
E	32	I	31	Q	30	M	29
D	33	L	34	H	35	P	36
F	40	S	39	B	38	O	37
S	41	A	42	E	43	L	44
C	48	M	47	J	46	F	45
I	49	B	50	P	51	T	52
K	56	O	55	H	54	R	53
N	57	G	58	Q	59	D	60

NREP 2001

LM YT 39

Cultivars	General description
A. Energyl	Design: 4 x 5 Lattice
B. ARC-RFI 132A κ	Sowing date: 22/03/2001
C. Midmar κ	Gross plot size: 2m x 6m
D. ARC-RFI 403 C T κ	Nett plot size: 1.4m x 4m
E. Exalta	Cutting height: 5 cm
F. ARC-RFI 123 A κ	Sowing rate:
G. ARC-RFI Lp 671 D κ	Diploids = 25 kg/ha
H. Barspectra T	Tetraploids (T) = 30kg/ha
I. ARC-RFI 491 T κ	
J. Etc....	

Annexure C: Example of a field data sheet for a cutting trial. PGW = Plot green weight; SGW = Sample Green Weight; SDW = Sample Dry Weight

Trial..... 20.....

Cut no..... Date...../...../20.....Location.....

Plot no.	PG W	SG W	SD W	Visual observations			Plot no.	PG W	SG W	SD W	Visual observations		
	kg	g	g					kg	g	g			
1							26						
2							27						
3							28						
4							29						
5							30						
6							31						
7							32						
8							33						
9							34						
10							35						
11							36						
12							37						
13							38						
14							39						
15							40						
16							41						
17							42						
18							43						
19							44						
20							45						
21							46						
22							47						
23							48						
24							49						
25							50						

PGW = Plot Green Weight
 SGW = Sample Green Weight
 SDW = Sample Dry Weight

Visual observations

W = weeds
 F = flowering
 R = rust

Rating system

1 = nil 3 = 50%
 1.5 = 12.5% 3.5 = 62.5%
 2 = 25% 4 = 75%

Fertilizer: