From Aust Seed Sci Newsletter 1:22 1975

Screening Pasture Species for Optimum Germination Temperatures Using a One-Way Thermogradient Germination Plate

A locally designed and built thermogradient germination plate has been used extensively over the past 4 years to make a rapid assessment of the optimum temperature for germination of a range of native and exotic pasture species for which little information is available. Though only constant temperatures could be used and light was almost completely excluded, it was felt that this technique offered the quickest results at a time when a minimum of seed was available.

The maximum temperature extremes which could comfortably be maintained on the plate were 42^{0} and $10^{o}C$, which gave a temperature gradient of $4^{o}C$ per 10 cm. However the actual range experienced was averaged over the full 21-day test period from daily readings, and intermediate values were calculated assuming a linear temperature gradient along the insulated plate. Three replicates of 25 seeds were arranged in rows at 10-cm intervals down the plate for each test run. The seeds were placed on an absorbent material (either cloth or paper) which ran the full length of the plate and germination counts were made at regular intervals, more frequently over the first few days.

TABLE 1

The two tables (Tables 1 and 2) give a summary of the results to illustrate a number of the important findings. Firstly there were some species which could not easily be induced to germinate under the conditions imposed on that particular batch of seed, namely *Aerva javanica* (kapok bush), *Schmidtia bulbosa* (Kalahari couch) on some occasions, *Aristida jerichoensis* (a wire grass), *Chenopodium auricomum* (Queensland bluebush), *Digitaria* species, *Monachather paradoxa* (mulga oats), *Panicum decompositum* (native millet), *Paspalidium rarum*, and caryopses of *Thyridolepis mitchelliana* (mulga Mitchell). Note only the first two species mentioned are exotic species and there were no legumes in the list of poor germinators. The reasons for poor germination have been largely elucidated since, in many cases, the seed was too fresh, e.g. *Digitaria* spp. and *A. jerichoensis*. The two native grasses *M. paradoxa* and *T. mitchelliana* are badly attacked by fungi and bacteria when germinated as caryopses. However in the case of *P. decompositum* later tests indicate a strong requirement exists for alternating temperatures or light in the higher temperature ranges.

TABLE 1

Native Species

Species	Seed condition	Seed age (months)	Opt.temp.°C (3-day test)	Opt.temp.°C (21-day test)	Possible temp. extremes (°C)	Maximum viability recorded (%)
Aristida jerichoensis	natural	6	-	16	40-12	27
Astrebla lappacea	natural	11	33	23	41-	69
Astrebla pectinata	caryopses	36	30	23-34	-	91
Chenopodium auricomum	perianth removed	42	23	10-16	37-	40
Dactyloctenium radulans	caryopses	66	34	27	-12	80
Digitaria ammophila	natural	42	30	27	40-12	49
Digitaria ammophila	natural	13	25	21	42-11	16
Digitaria ammophila	natural	11	27	27	34-14	17
Digitaria diminuta	natural	42	31	20-30	40-12	43
Digitaria diminuta	natural	10	27	23	38-12	7
Monachather paradoxa	natural	38	-	17	23-13	3
Monachather paradoxa	caryopses	13	23-34	21	38-	9
Panicum decompositum	natural	32	-	16	28-	47
Paspalidium rarum	natural	42	23-34	23	38-13	5
Psoralea eriantha	scarified	13	16-20	11-27	41-	99
Psoralea tenax	scarified	35	20-30	11-30	-	95
Rhynchosia minima	scarified	30	23-27	20-27	41-11	93
Thyridolepis mitchelliana	natural	18	24-27	13-27	35-	93
Thyridolepis mitchelliana	caryopses	11	30	30	41-11	54

TABLE 2

Exotic Species

Species and strain	Seed condition	Seed age (months)	Opt.temp.°C (3-day test)	Opt.temp.°C (21-day test)	Possible temp. extremes (°C)	Maximum viability recorded (%)
Anthephora pubescens CPI 43713	caryopses	23	24-28	24-28	-	84
Anthephora pubescens CPI 43713	fascicles	18	24	17-21	41-	55
Aerva javanica 'Cloncurry'	natural	2	32	32	41-12	8
Aerva javanica 'Cloncurry'	fluff removed	2	32	21	-11	31
Aerva javanica 'Kununurra'	fluff removed	60	24	24	42-12	15
Cenchrus ciliaris cv.Biloela	caryopses	48	28	21-28	-	96
Cenchrus ciliaris Q10077	fascicles	17	28	NA	-	>50
Cenchrus ciliaris Q10077	caryopses	17	24	21	-	96
Cenchrus ciliaris Q10087	fascicles	17	32	24	-12	69
Cenchrus ciliaris Q10087	caryopses	17	24-28	NA	-12	>95
Clitoria ternatea Q4116	scarified	10	28	17-32	41-	100
Dactyloctenium giganteum Q10091	caryopses	42	39	39	-	65
Eragrostis curvula CPI 30379	caryopses	21	32	32	41-	91
Eragrostis curvula CPI 33944	caryopses	18	24-38	21-24	41-	97
Melilotus alba var. *annua*	scarified	24	20-27	10-31	37-	100
Rhynchosia minima CPI 36696	scarified	24	27-31	20-31	40-	93
Schmidtia bulbosa CPI 43715	fascicles	19	28	17-21	-	53
Schmidtia bulbosa CPI 43715	caryopses	12	28-31	17-24	-	93
Schmidtia bulbosa CPI 43715	caryopses	9	32	32	-12	24
Stylosanthes mucronata CPI 41219	scarified	20	20	17-20	-	81

Optimum temperatures for rapid germination were generally higher than for total viability at 21 days or had a higher maximum to the optimum range. Whether this is a real effect or due to greater pathogen damage at the higher temperatures as time increased is not known for certain, but pathogens are felt to be the cause. There were no species with a marked peak germination at a particular temperature and in fact a surprisingly wide range of temperatures was suitable for high germination of most species, particularly the legumes. Both *Dactyloctenium* species had comparatively high optimum temperatures for rapid germination and showed a distinctly lower germination in the range 25° to 32°C than at temperatures above and below this range.

The range of temperatures over which germination would occur for most species was quite large, usually in the vicinity of 12-40°C. However some species germinated over the entire range used, notably *Psoralea tenax*, *Stylosanthes mucronata*, and some of the exotic grass species. In general the legumes would not germinate well at high temperatures, particularly the *Melilotus* sp., which is a winter annual. The two *E. curvula* lines showed a very strong dislike for temperatures of 41°C even though they germinated almost fully at 38°C. Spikelets of *T. mitchelliana* showed a much narrower range of preferred temperatures for germination than its caryopses and this observation would apply also to fascicles of *C. ciliaris* and *A. pubescens*.

In summary the native species presented more germination difficulties than the exotics and the grasses were harder to germinate than the scarified legume seeds, with our present state of knowledge. Fresh seed or grass seeds with their floral appendages intact were often difficult to germinate. Seed coats also appeared to reduce the temperature range over which germination would occur. Adaptability to a wide range of temperatures for germination was exhibited by most species but very high temperatures certainly did not suit most species, despite their tropical origins.

R.G. Silcock and Lynn M. Williams
Department of Primary Industries,
Queensland