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Drought effects on wheat cultivars using trickle irrigation

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FIELD EXPERIMENT SUMMARY 1974 - R.N. WEIR

Drought Effects on Wheat Cultivars Using Trickle Irrigation

TRIAL 74M32

The trial was aimed at -

1. Looking for cultivar differences in drought tolerance particularly involving Gamenya and Insignia.
2. Considering trickle irrigation as a means of controlled water application.

Four cultivars were sown at the end of July in salmon gum soil at Merredin.

Irrigation was commenced at the beginning of October about 11 to 18 days before anthesis. Gambee was the earliest to flower (approx. 13/10) and Darkan was the latest (approx. 20/10). Up to 7/11 some 16.8 cm of water was applied at 2.5 cm/week, this being applied in one hour.

Despite precautions, jostling sheep managed to move the valve controlling the irrigation, resulting in some 250 cm of water being applied in four days prior to 13/11/74. The area flooded was marked out at the time and holes put down to see if any lateral movement of water was occurring. It was decided therefore to hand harvest two reps. of 4 row x 5 metre plots of watered (W) and unwatered (UW). Only one suitable area of unwatered Darkan could be found. In addition one plot of each cultivar was taken which had been unwatered up to the time of flooding and had then been subjected to excess water (F).

Apart from guarding against accidental watering the method of application of water was satisfactory. Water was confined closely to the site of application. Apparently 2 - 3 rows from the point of application were all that was needed to separate watered and non-watered plots.

Approximately 1 week after flowering signs of stress such as leaf rolling was evident in unwatered treatments except Darkan. Gambee showed severe leaf rolling, while Insignia and Gamenya showed some flag leaf senescence. Height differences of the order of 15 - 20 cm were seen between irrigated and non irrigated plots.

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Results obtained are shown below.

74M32

YIELDS kg/ha

	Watered (W) +	Unwatered (UW) +	$\frac{UW}{W}$ %	Unwatered then satur- ated (F)*	$\frac{F}{W}$ %
Insignia	3674.3	1862.9	51	2257.1	61
Gamenya	3360.0	2005.7	60	2428.6	72
Darkan	3431.4	1705.7*	50	1991.4	58
Gambee	3282.9	1665.7	51	2317.1	71

+ mean of 2 plots

* only 1 plot obtained

The figures cannot be analysed for some weeks. It would appear however that Gamenya is not inferior to Insignia in dry conditions but may well be better.

The high yield of Insignia under the high water regime (W) and its poor yield under the late watered treatment (F) is a little surprising.

The later watering (flooding) was approximately 4 weeks after anthesis and showed that all cultivars were able to make use of it.

The hectolitre weight, 1000 kernel weight and proportion of grains larger than 2.0 mm were also measured. The former was done using a 500ml chondrometer while the latter was done on a dockage tester. Head numbers were estimated from sub-samples.

	Hectolitre wt.		grain passing through 2mm sieve %	1000 kernel weight		Head numbers	
	kg/Hl	%		mg	%	per 20 row	%
IS W	84.3		2.2	42.1		1008	
UW	79.5	94	3.3	31.1	74	791	78
F	80.0	95	2.4	32.4	77	966	96
GM W	82.8		1.1	41.4		752	
UW	79.0	95	1.5	33.4	81	714	95
F	78.0	94	1.6	33.1	80	855	114
DK W	84.3		1.1	47.3		703	
UW	80.3	95	1.5	35.4	75	589	84
F	80.3	95	1.7	36.4	77	628	89
GB W	83.3		0.3	49.9		886	
UW	81.3	98	1.1	38.9	78	646	73
F	80.5	97	0.6	37.3	75	941	106

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Conclusions

The figures cannot be analysed for some weeks but since at best only two replications were available the results should be viewed with caution. It would appear that Gamenya is not inferior to Insignia under dry conditions but may well be superior.

Hectolitre weights recorded were all above the receival standard of 74 kg/Hl and the proportion passing through a 2 mm sieve was better than receival standard of 5%. So not even the stressed grain was substandard. It is apparent that the level of moisture stress was sufficient to give visible stress effects such as leaf rolling, more rapid leaf senescence and stem shortening, was not sufficient to affect hectolitre weight or pinched grain percentage, even though grain weight was reduced. The recovery of grain yield accompanying the late watering (F) was due more to increased head number than to grain weight. Here again no special drought resistance could be seen in Insignia.

The results of the field differed from those obtained in an experiment carried out in a controlled temperature glasshouse.

Drought Effects on Four Wheat Cultivars in Controlled Environment

TRIAL 74GL8

This work was aimed at assessing the performance of the cultivars Gamenya, Gambee, Darkan and Insignia under controlled moisture stress.

Two gallon buckets of Salmon Gum red clay were sown on July 2nd, 1974 with the four cultivars thinned to two plants per pot. They were grown in a controlled temperature of 20°C day 15°C night with natural light. All pots were covered with 2 cm of alkathene pellets to minimise evaporation. Five control plots (T1) of each cultivar were maintained at or slightly above field capacity throughout. A similar set of pots (T2) was given only 50% of the water applied to the controls while a further set (T3) was given 25% of the amount added to controls. These treatments were applied at ear peep. Control pots were never allowed to fall below about 0.7 atm. soil moisture tension. The most severe treatment reached stress conditions of 15 atm. soil moisture tension less than a week after first anthesis. This treatment showed typical stress symptoms such as leaf rolling and suppression of stem extension.

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The water use recorded was least for Gamanya and greatest for Darkan as seen below. Only the T1 values are shown. T2 + T3 would of course be 50% and 25% of this respectively.

	Water used by control treat. (ml)	Equivalent cm of rainfall
Gambee	6062	13.41
Darkan	6242	13.81
Gamanya	5882	13.01
Insignia	5992	13.26

The degree of stress imposed can be seen from the reduction in lengths of peduncle in treats 2 and 3. Figures shown are means of tree stems per treatment (approx. 40).

Peduncle lengths as % of control (T1) values -

	Gambee	Darkan	Gamanya	Insignia
T2	74.9	80.2	82.7	78.5
T3	67.1	64.6	71.6	58.8

The results in terms of yield are shown below -
MEAN YIELDS g per pot

Treatment		Gambee	Darkan	Gamanya	Insignia
Adequate water (15% SM)	T1	11.9	14.5	12.9	12.6
50% of T1 water added	T2	9.5	11.1	10.3	11.8
25% of T1 water added	T3	6.8	7.7	6.8	8.4

There were 5 pots (each having 2 plants) of each treatment. Under adequate moisture conditions Darkan was superior while in sub-optimum moisture conditions Insignia had a clear advantage. In fact this superior performance under dry conditions can be seen in the values for grain weight and number.

Mean percentage of control treatment.

		Gambee	Darkan	Gamanya	Insignia
Yield	T2	80	76	80	94
	T3	57	53	53	66
Grain Number	T2	84	83	81	95
	T3	71	71	68	74
Mean seed weight	T2	96	92	98	98
	T3	82	76	76	90

It can be seen that the 50% water treatment had little effect on yield, grain number or weight for Insignia and this cultivar advantage was maintained under the more severe 25% water treatments. It can be argued that the performance of Insignia is consistent with its low potential yield. However in this work the yield of Gambee control was lowest but it was unable to maintain a high percentage of this under stress conditions.

The means by which Insignia achieved its better performance can be seen in its ability to maintain grain weight. This is consistent with farmer opinion. Insignia did show a greater reduction of peduncle length under moisture stress than other cultivars.

No plant water content measurements were made so it cannot be established whether the reduced extension growth of Insignia was an expression of a greater soil or plant water deficit or the result of a greater sensitivity to a given deficit. The latter case would constitute a drought escape mechanism and is the most likely.

Comparison of Drought experiments in field and controlled temperature glasshouse.

The difference in results obtained in the two experiments are difficult to explain without comparable measurements being made on both. The yields from the field experiment are per unit area whereas those from the controlled temperature are for free standing plants. This in itself could lead to varietal differences.

The yield reduction obtained in the field experiment (51 - 60%) are comparable to those obtained in T3 of the controlled temperature trial (53 - 66%). The field experiment was also similar in terms of seed weight reduction (74 - 81%) as compared to (76 - 90%) for the other trial.

It is hoped that both trials can be repeated in the coming year with better replication and control in the field. Both trials should have plant water status measurements and comparable morphological measurements or observations.