The effect of irrigation on the yield of *Macadamia integrifolia* (cultivar 246) for the harvest year of 2007 at Clunes, Northern New South Wales, Australia

Col Peak and Ned Sutherland

Abstract

I*n a season of below average rainfall., irrigation increased yield of Macadamia var. 246 from 10.54 kilograms per tree of nut in shell (10 % moisture nis) for non irrigated trees to 20 .79 kilograms (10% moisture nis) for irrigated trees, an increase of 97 %.*

The study was undertaken on trees of thirty years of age planted on deep, well drained krasnozem soils planted at a density of 200 trees per hectare.

Harvest data was collected from a total of 1781 trees divided into approximately two equal groups representing irrigated and non irrigated treatments. Irrigation was scheduled according to soil moisture conditions measured using continuous soil moisture monitoring instrumentation.

Introduction

Macadamia in Northern New South Wales are generally grown without supplementary irrigation.

Local anecdotal observations [1] suggest that irrigation may be beneficial in years of below average rainfall but such observations have yet to be quantified.

Our data is based on information gained over a period of one season only and is considered by the authors as an interim report. It is anticipated that additional data collection and the development of irrigation management strategies will be undertaken for the forthcoming season 2007-08.

Aim.

1. To compare the effect of irrigation on yield and nut quality for the season 2006 – 2007.

2. To develop management guidelines for scheduling irrigation to maximise irrigation efficiency

Materials and methods

Trees

The trial utilised 1781 trees of 30 years of age planted at density of 200 trees per hectare. Tree spacings are 5 meters within rows and 10 meters between rows. Tree cultivar is predominately 246 (98 %) for both treatments with the remained 2 % comprising of the cultivar 508.

1 Rothwell, Lee personal communication Sept 2007.

The trial comprised of two treatments classified simply as irrigated and non-irrigated. Treatment 1 (control) was not irrigated and comprised of a total of 940 trees. Treatment 2 was the irrigated treatment and comprised of 841 trees.

Soils

Soils on which the trees are planted comprise of deep well drained krasnozems (ferrosols) typical of the soils on which macadamias are grown in Northern New South Wales. The terrain could be classified as gently sloping and suitable for year round use of all farm machinery.

Soil moisture monitoring.

Soil moisture in the irrigated treatment was measured using a multi– level soil moisture sensor [2] which provided information on soil moisture at depths of 10, 20, 30, 50 and 80 cm.. Information from the soil sensor was collected at 30-minute intervals and uploaded to an Internet based data facility using general packet radio service (GPRS) telephony and Internet enabled field transmission device [3]. The field information could be viewed and downloaded over the Internet in graphical and tabulated format for irrigation scheduling purposes[4].

Irrigation scheduling

Irrigation was applied when the soil moisture showed a relative drop of 30 % below our estimated level of field capacity. The value equated to 32 % soil moisture level (v/v) derived using the Sentek soil moisture default conversion coefficient for clay loam soil

Rainfall data

Rainfall data was obtained from the Bureau of Meteorology weather station located at the Department of Primary Industries site at Alstonville, New South Wales. (BOM Reference site number 058131 Tropical Fruit Research Station) which is 15 kms distance from Benny's Creek Farm. Rainfall was recorded at Benny's Creek Farm using a manual raingauge.

2 Sentek (Australia)
3 Environment Information Technology (Australia)
4 Peak Irrigation Management Service – www.peakmonitoring.com,au

Results

Rainfall records

Site	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*AVG*	*YEARS*
Alstonville	170	227	265	189	184	158	90	74	53	101	127	149	1783	44
Alstonville 2006	530	94	319	98	65	97	87	200	151	7	90	80	1816	1
Alstonville 2007	28	95	83	58	39	88	5	262						
B.C. Farm 06									151	0	114	76		
B.C. Farm 07	76	82	122	59	46	86	0	200						

Table 1: Rainfall

Harvest data

Harvest No	***Date***	***Treatment 1 NIS (kg) 10% moisture***	***T 1 SKR***	***T 1 Non SKR***	***Treatment 2 NIS (kg) 10 % moisture***	***T 2 SKR***	***T 2 Non SKR***
1	11/05/07				3639	26.2	5.8
2	22/05/07	5376	32.48	2.2			
3	09/07/07				8881	32.22	1.24
4	18/07/07	4968	30.1	3.25			
5	01/08/07				4536	35.2	1.8
Total (kgs)		10344			17056		
Number of trees		940			841		
Average kg / tree		11.00			20.28		

Table 2: Harvest data

Soil moisture monitoring

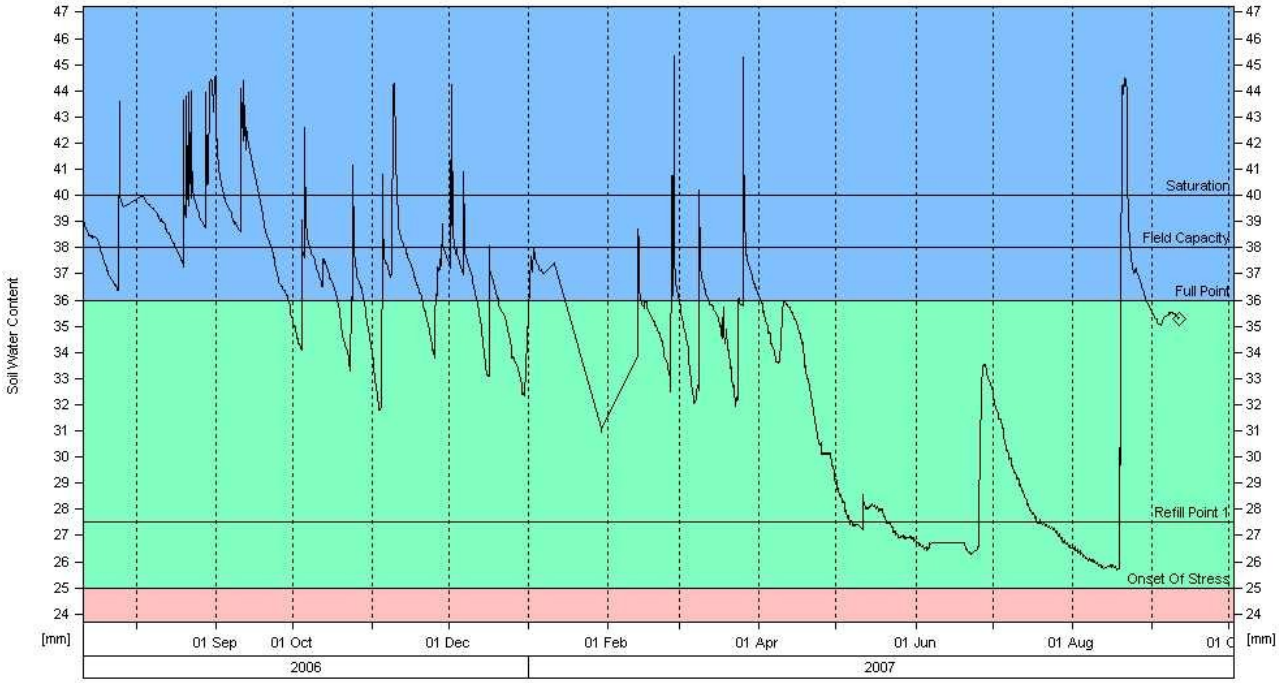

Table 3: Soil mositure

Discussion

Rainfall

Rainfall in August and September of 2006 was well above the long term monthly averages . These months were then followed by a prolonged period of eleven months of below average rainfall. (Table 1).

Soil moisture

Irrigation was applied in order to maintain relatively high soil moisture conditions throughout the period of nut maturity. Soil moisture was probably held a little too high and future irrigation will be managed between upper and lower levels between 28 and 38 % soil moisture.

The soil moisture monitoring data shown in table 4 shows the trend line of soil moisture measured at 30 minute intervals for the period Aug 06 – September 07. In June and August 07 we experienced a number of prolonger dry periods during which irrigation was not required due to harvesting activities. .

The rate of soil moisture depletion appears steady until a lower level of around 28 % soil moisture is encountered. At this level the slope of the depletion curve changes indicating a reduction in the rate of soil mositure loss from the soil. We shall use this change in slope characteristic to define an irrigation setpoint and base future irrigation scheduling activities on this point on the soil chart. Soil data shown in Table for represents soil moisture

measured at 30 cm below the soil surface. The soil sensor used in the experiment provides data at five separate depths. The five sensors provide excellent data on through profile drainage and will be used to fine tune duration of irrigation events in order maximise irrigation efficiency. The same sensor data will be used to manage the placement of fertilisers applied by way of the in-line fertiliser injector this coming season. For the purpose of this report the sensor located at 30 cm provided good soil moisture data on which to base irrigation scheduling.

Yield

Harvest data is shown in Table 2. The irrigated treatment yielded a harvest increase 97% greater than the non-irrigated treatment. Both treatments were subject to the same management activities as pruning, site maintenance and fertiliser programs. The orientation of the trees in both treatments were identical being a north – south orientation on similar slope and soil type.

Nut quality

Nut quality (sound kernel recovery , SKR) for the first harvest in the irrigated treatment was lower than subsequent harvests for both treatments. Grower experience (Ned Sutherland) is that this is 'normal' for this property for the first early harvest. The two following harvests from the irrigated section had SKR grades equal to, or better than the non – irrigated treatment.

Conclusions

Based on a limited trial period conducted over a season of below average rain, the results show a significant positive response to irrigation with a yield increase of 97 % almost compared to that on non-irrigated trees.

About the authors

Ned Sutherland is owner of Benny's Creek Macadamia farm located at Clunes, New South Wales, Australia. Ned has managed the farm for a period of 20 years and employs specialist agricultural consulting services for advice on fertiliser management and IPM pest and disease programs. In 2000 Ned undertook and completed the NSW DPI WaterWise Farm Course.

Col Peak is a Certified Irrigation Agronomist with extensive background in soil mositure monitoring systems, irrigation scheduling and agricultural science. Col is manager of Peak Environmental Monitoring services established in 1996. see www.peakmonitoring.com.au

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