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The relationship between Previous Years Rainfall Totals, and Yield of Protea Pink Ice

Location: Crows Nest, Queensland
Soil Type: Deep Red Ferrosol
Crop: Protea Pink Ice (Hybrid of *P. Neriifolia* and *P. Susannae*)
Latitude = -27.26
Longitude = 152.06

Summary
Data from Pink Ice harvest totals from a local dry land flower grower and rainfall totals from the Bureau of Meteorology were collected to determine any relationships between rainfall totals and harvestable stems. Total average annual rainfall for the region since 1889 was 855.5mm, however, for the past 15 years since plantation has started, the average is down to 742.7mm. A relationship between rainfall and harvestable stems was observed, with yields becoming quite acceptable when 800mm or more had fallen in the previous year, however, when rainfall dipped below 600mm, yields were very poor. This indicates that protea pink ice, will need to be supplemented with irrigation in years where there is less than 600mm of rain.

Introduction

Climate variability, and inconsistent rainfall patterns in South East Queensland over the past 15 years, has had an impact on the quality and quantity of flowers for protea growers. Currently there is insufficient information on the amount of irrigation needed to be applied to Protea plants to maintain quality and quantity of harvestable stems. Previous trials (*Mortimer et al*) had failed to find a definitive response to different irrigation quantities with *protea spp* in the field, and as there was little information published, there remains varying opinion on what these crops require and when they require it. Discussions with a local grower regarding his dry-land farming techniques informed me that irrigation water had never been applied to his crop in the form of irrigation and it was thought that results may be obtained by comparing rainfall totals with the growers' pink ice stem yields over the past fifteen years. The aim of this study was to identify a relationship between amount of rainfall and yield, in order to ascertain the amount of rainfall needed to produce good harvest yields and at what times of the year irrigation may have most heavily influenced yield. Protea Pink Ice stems, like many others from the Proteacea family, grow in what is called Rests. Generally there are about 5-6 rests between flowering, and 3-4 rests per year, which means each protea stem grows for one whole year before it is able to flower in the second year. This is why, when looking at yield and stem length, one needed to look at the previous year's rainfall (PYR) for to identify any relationship that may exist. The growth from one rest to another gives an indication of the vegetative growth that was happening at each growth stage, and therefore how much water was available to the plant at this time. Conclusions derived from this study are anticipated to assist protea growers in identifying crop water needs, and assist growers in determining their irrigation scheduling with limited water supplies.

Methods and Materials

The grower recorded stem length, harvest dates, and total stems harvested over the life of his Protea Pink Ice plantation (1992-2007). Of the original 3500 plants planted, at the end of 2007 there were still 3250 trees still alive. He recorded total stems harvested from the years 1993 to 2007, (see harvest totals in figure 2) and gave the Flower Association of Queensland Inc (FAQI) a copy of the records to analyse. Rainfall totals on farm were never recorded, so historical Rainfall totals were obtained from the Bureau of Meteorology for the region Crows Nest, station number 040382. The data was in the form of Daily totals, and therefore rainfall intensity was not taken into consideration, which could have had an impact on the total amount of water entering the soil due to runoff. As these protea pink ice plants had never been irrigated, all water inputs were received in the form of rainfall. See Rainfall totals in Figure 1.

Figure 1.

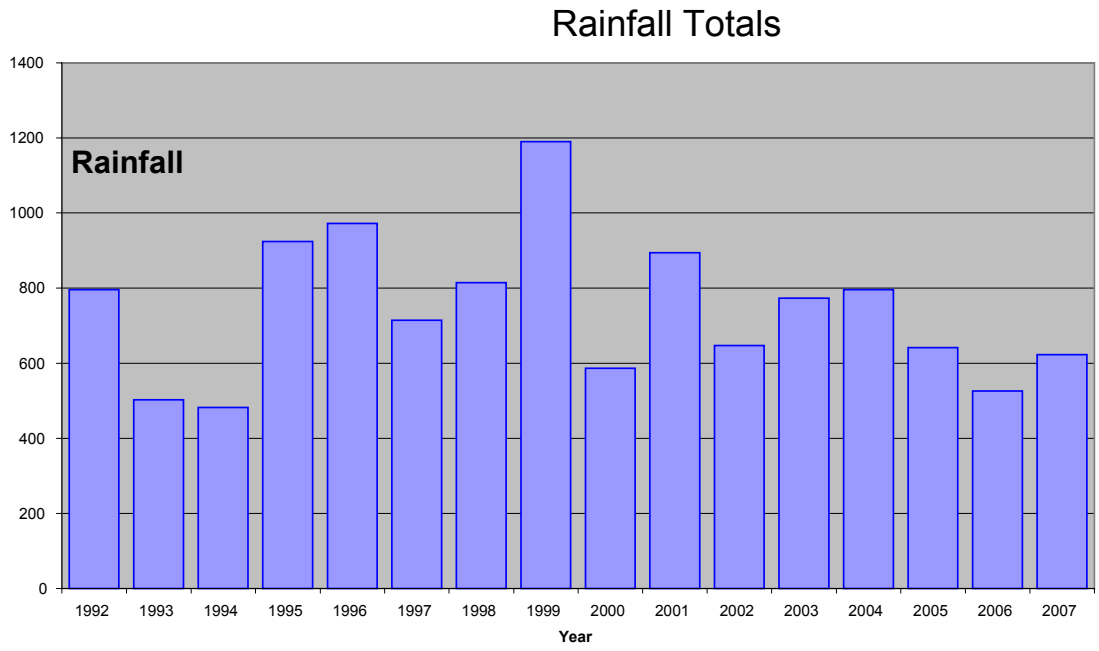
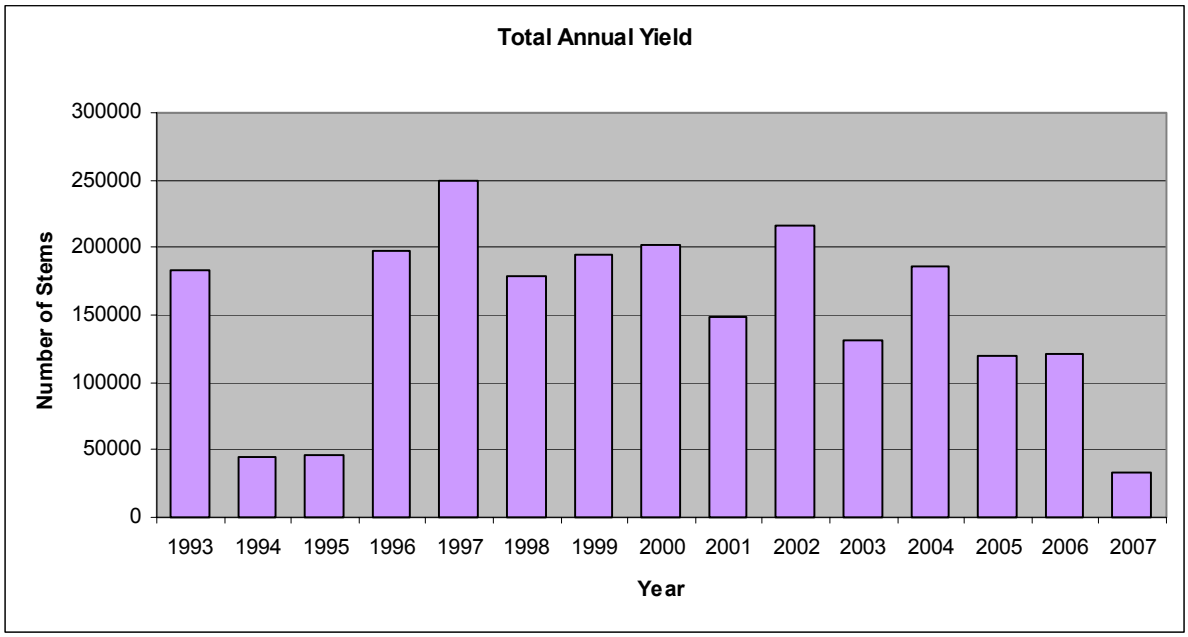


Figure 2



Results

Overall yield trends were found to be related to the previous years' rainfall totals. *(See Figure 4)* Years with rainfall totals near 800mm or more, produced yields of 180,000 plus stems the following years harvest. In years where there was less than 800mm of rainfall, yields dropped off considerably. The 3 driest years 1993, 1994 and 2006 produced the 3 worst harvest record the farm had experienced with 44298, 45851 and 32484 stems respectively.

The best harvest yields in total stems happened in 1996, 1997, 1999, 2000 and 2002. If we look at rainfall totals for the year preceding those good harvests, we find that in February and March in 1995 the soil profile must have been filled up with a total of 310.6mm of rain in those 2 months, the rest of the year there was little until November and December where it

received another 352.8mm. Yields in 1996 were very good with almost 200,000 stems being produced. However in 1996, instead of getting the rain only in summer months, it received most of the rain in May, with average rainfall totals for the other months of the year. This subsequently produced the largest yield recorded at this farm to date. Both years received over the 800mm of rainfall, and the protea plants produced better than average yields.

When looking at the Average Rainfall totals for the known history of Crows Nest, average rainfall totals are 855mm/year and average ETo is 1608mm. Comparing this with the average totals for the past 14 years, and rainfall is down to 742mm/year.

Figure 3

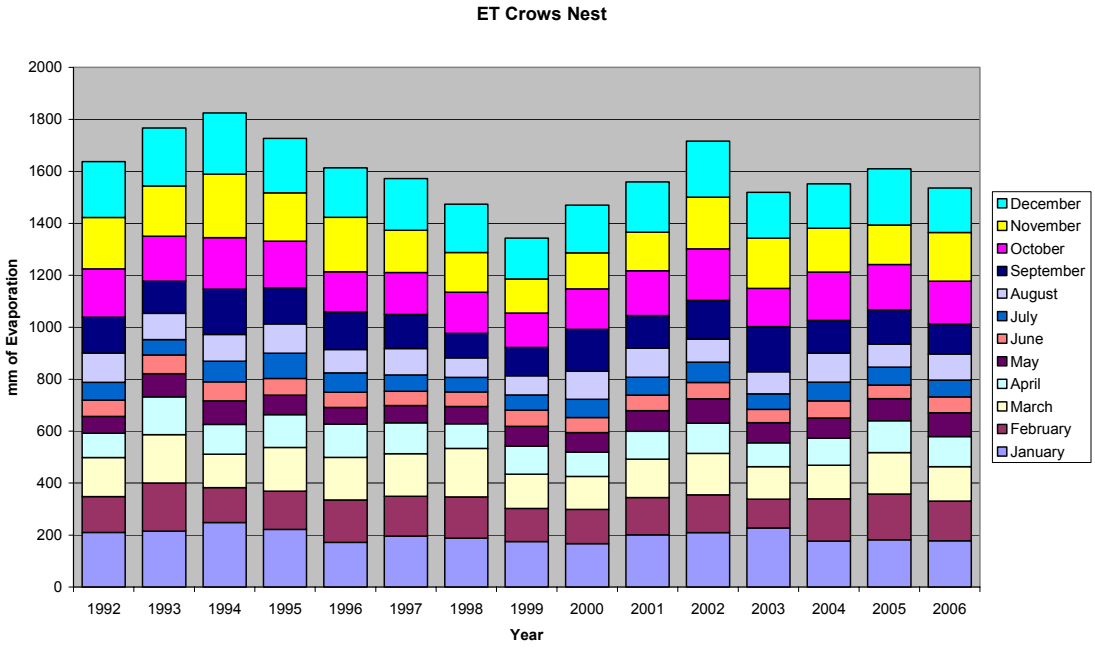


Figure 4

High	>900mm
Average	750mm
Low	<600mm

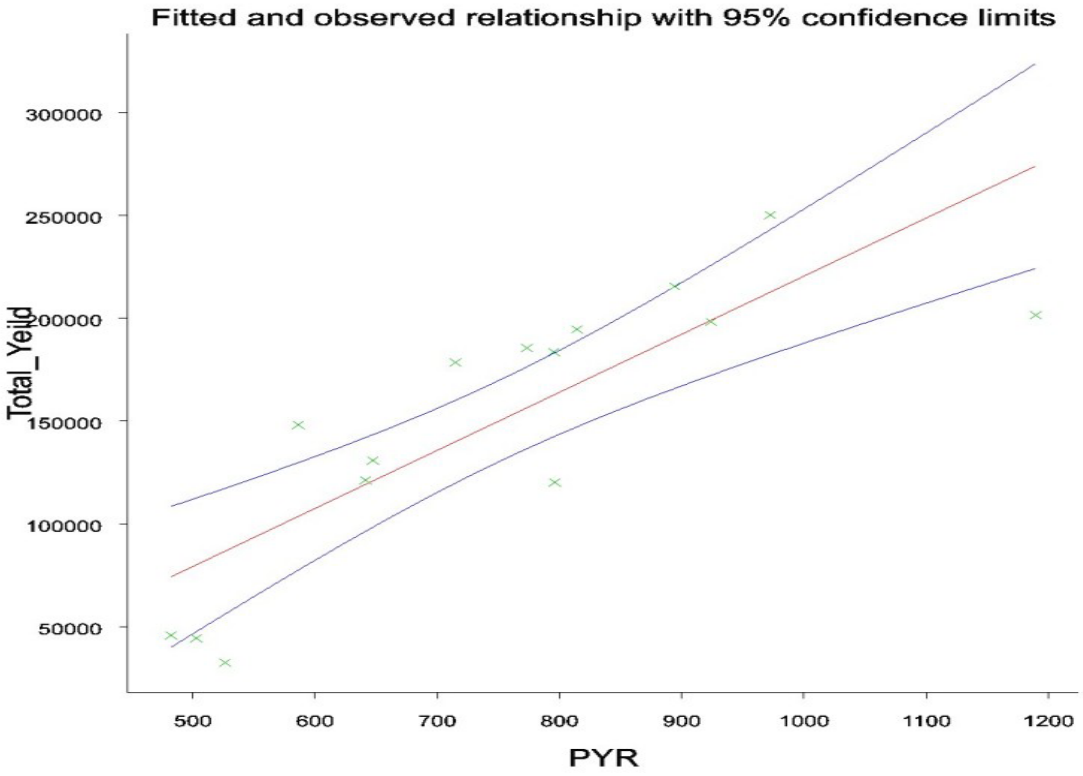
Low			Average			High		
Year	Rainfall	Yield	Year	Rainfall	Yield	Year	Rainfall	Yield
1994	482.2	45851	**2007**	622.7		**1995**	924.1	198263
1993	502.7	44298	**2005**	641.6	121241	**1996**	972.3	250214
2006	526.2	32484	**2002**	647.4	130849	**1999**	1189.6	201428
2000	586.4	215628	**1997**	714.8	178499			
			2003	773.2	185558			
			1992	795.7	183597			
			2004	796	120222			
			1998	814.4	194669			
			2001	894.2	215628			

Timing of water application also appears to have a substantial impact. Studies of Protea Pink Ice in South Australia, showed 'pink ice has growth flushes between August-September, reached peak growth in October, and fell to low levels of growth in December.' (Et al Barth, N.A.) In South Australia, the harvest period is later than in Queensland, (March through to November compared with January to May in Queensland, so assumptions that the growth flushes were at similar but probably earlier times in Crows Nest, Queensland could be made. This indicates that there is crop water requirement during this part of the growing season, and in Queensland it is rare to get good rainfall in this period. Years with exceptionally low winter rainfall (2000, 2002 and 2004) especially in the months of June, July, August and September resulted in poor yields in 2001, 2003 and 2005. . In Queensland, where summer rainfall is more common than winter rainfall, there may be a greater need to apply water in winter times.

Most of the variance in rainfall in Crows Nest happened during the winter months, and this is actually the timing of natural rainfall patterns in South Africa from where these crops have originated.

In 1998, yields slightly decreased, and total rainfall for the year was less than 800mm, with no profile filling rainfall throughout the year until December. In 1999 and 2000 there were above average yield, and again over 800mm of rainfall had fallen in the year preceding. In 2001, we noticed the first real large downturn in yield from this crop. When looking at the rainfall totals, it was also one of the driest years in this study, with no great amounts of rainfall happening through out the whole year until December, and the driest winter since 1994, which was also a very poor harvest year, although some of the crop was lost to hail in that year. In 2002, things picked up again with total stems breaking the 200,000 mark for only the 3rd time. The rainfall this time fell in February 2001, with small rainfall events through winter, and good October, November and December rains. Declining rainfall levels over the years started a downward trend in yields, with 2003, 2005, 2006 and 2007 being the worst years on record except for the years of 1994 and 1995, which had the least rainfall totals of any year apart from 2007.

Figure 5



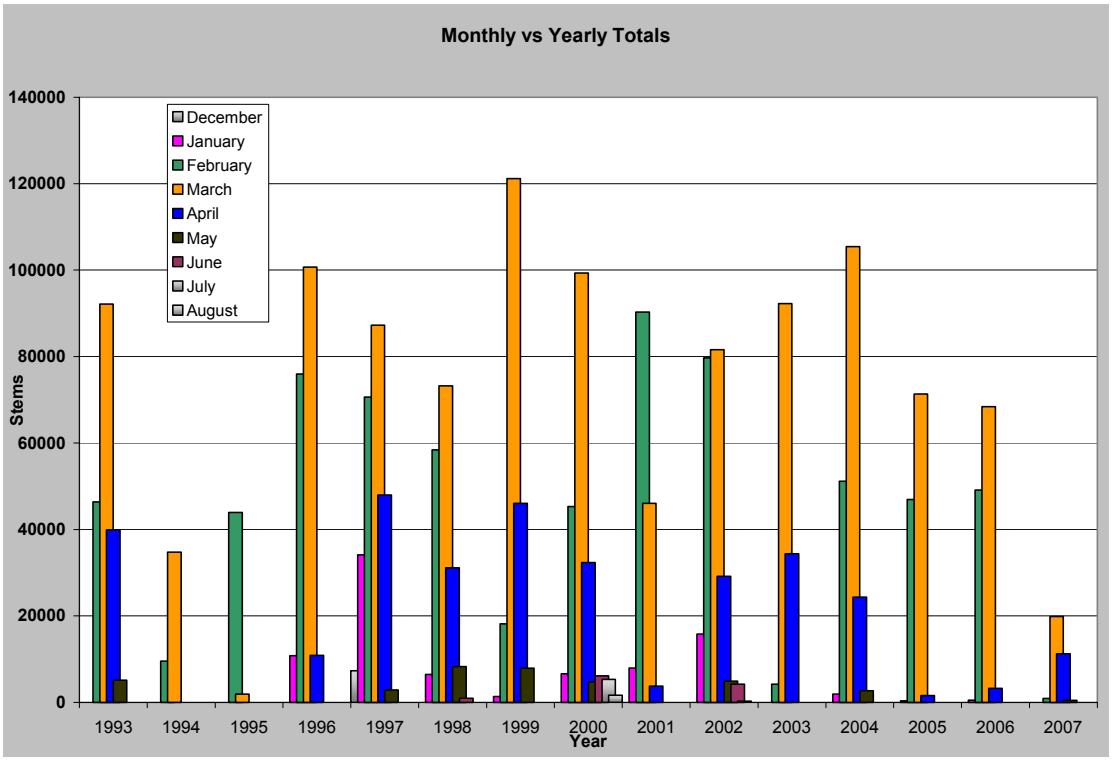
Discussion

Flowering time also varied from year to year, and although there is not enough data to conclude what caused this variance, future studies should look at calculating heat or chill units to determine what influences they have on flowering. From year to year there are variances in the timing of harvest and the length of the harvest season. (See Figure 6) This could be due to a combination of the variable listed above.

Conclusion

There appears to be a strong correlation between the preceding year's rainfall totals and the total number of harvested stems from protea pink ice. As observed in the data, there was a correlation between acceptable stem yields in years with total rainfall over 800mm per year. With climactic conditions proving to be less and less predicable, there is evidence that supplementary irrigations during times of greatest plant response may improve yield consistency, and if more can be learned on how to manipulate flowering time. *(see figure 6)*

Figure 6



Reference:

Mortimer, P.; Swart, J.C.; Valentine A.J.; Jacobs, G.; Cramer, M.D.
Does irrigation influence the growth, yield and water use efficiency of the Protea hybrid 'Sylvia' (Protea Susanne x Protea Eximia), South African Journal of Botany, Vol 69 July 2003 pp 135-143

Barth, G.E., Maier, N.A., Cecil, J.S., Chyvl, W.L., and Bartetzko, M.N.
Yeild and seasonal growth flushing of Protea 'Pink Ice' and Leucodendron 'Silvan Red' in South Australia. Australian Journal of Experimental Agriculture, 1996 pp869-75

Figure 7

Total Stem Harvest

Year	30cm	40cm	50cm	60cm	70cm	80cm	90cm	100cm	110cm	120cm	Total
1993	0	17157	25785	38821	39415	37773	14772	7331	3164	1118	**183597**
1994	0	4838	7128	9232	8250	9338	2696	1620	913	283	**44298**
1995	0	114	710	2693	9211	15561	11891	4563	908	200	**45851**
1996	79	41546	52261	47068	25371	11180	11244	6092	2504	978	**198263**
1997	0	7230	33638	13503	48232	40898	30811	35056	23664	17182	**250214**
1998	0	9735	26266	37630	36152	22746	16291	9824	4735	2368	**178499**
1999	0	9596	16517	24662	36228	38097	25777	21727	11321	10674	**194669**
2000	0	3879	32451	48210	37650	25883	19128	24664	0	9563	**201428**
2001	0	0	10910	17361	33633	28906	23211	19444	9738	4866	**148069**
2002	0	15211	36072	47385	37265	37661	11396	22468	517	7653	**215628**
2003	0	317	22835	39257	35472	21126	8986	2856	0	0	**130849**
2004	785	16864	37603	41400	35380	28557	15901	10377	0	0	**185558**
2005	0	2506	12791	26496	27466	25348	17029	6925	1629	32	**120222**
2006	0	0	17873	25800	27966	26718	13236	9208	440	0	**121241**
2007	0	1918	5665	8981	7742	5371	2007	800	0	0	**32484**
	864	**130911**	**338505**	**428499**	**445433**	**375163**	**224376**	**182955**	**59533**	**54917**	**2250870**

Rainfall Totals

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Total
1992	125.7	181.5	81	64.1	59.6	2.5	45.9	36	57.9	26.8	66.6	48.1	**795.7**
1993	109	44.6	5.8	11.6	48.2	11.4	45.2	18.8	42.8	48.1	39.8	77.4	**502.7**
1994	7.2	148.8	159.3	18.7	11.4	20	8	0.2	11.8	32	19.8	45	**482.2**
1995	56.8	179.8	130.8	7.4	34.4	55.3	5.8	12.4	36.6	52	186.6	166.2	**924.1**
1996	157.4	66.7	16.2	47.2	333.8	8.6	43.2	47	40.2	45.2	80	86.8	**972.3**
1997	13.6	147.4	17.4	16.8	76.4	15.8	13.6	9	56.2	118	73.8	156.8	**714.8**
1998	92	96	25.4	93.2	118.2	25.6	41.2	66.6	146.8	15.8	29.6	64	**814.4**
1999	142.8	335.4	101.2	17.6	38.6	37	88	56.4	54.6	78.4	70.8	168.8	**1189.6**
2000	78.8	51.6	55.8	39.2	54.8	33.4	19.4	6	1	73.6	71.2	101.6	**586.4**
2001	54	259.6	32.4	61	22.6	8.6	48.2	8.4	22.6	88.6	176.2	112	**894.2**
2002	22	106	128.6	8.6	18.8	50.2	0	47.8	16	39.6	42.4	167.4	**647.4**
2003	0.2	224.2	46.2	142	30.8	51.4	15.6	16.8	2.6	96.4	3.6	143.4	**773.2**
2004	170.4	86.4	94.2	26.2	12.2	2	9.8	20.6	23	34.4	163	153.8	**796**
2005	116.6	12.4	22.4	13.8	22.8	97.2	6.6	8.6	22.2	193.8	44.2	81	**641.6**
2006	106.2	52.4	27.4	12.8	13.2	10.6	46	23.8	69.6	4	79.6	80.6	**526.2**
2007	59.2	42.6	32.4	27.6	24.6	94	0.6	77.6	22	67.6	95	79.5	**622.7**

Year	Rain	Yield in Stems	Total ET
1992	795.7		1637.4
1993	502.7	183597	1766.8
1994	482.2	44298	1824.6
1995	924.1	45851	1727
1996	972.3	198263	1613
1997	714.8	250214	1572.4
1998	814.4	178499	1473.2
1999	1189.6	194669	1343
2000	586.4	201428	1469.6
2001	894.2	148069	1559.6
2002	647.4	215628	1716
2003	773.2	130849	1519.2
2004	796	185558	1551.8
2005	641.6	120222	1609.6
2006	526.2	121241	1535.2
2007		32484	