

Evaluating the Fit of Long Season Oat Varieties as Alternative Hay Varieties in South-West Western Australia

Acknowledgements: This project is AEXCO funded and GRDC funded through the Department of Agriculture and Food break crop project. This trial was carried out by ConsultAg (Narrogin), in collaboration with Peter Dowdell (Gilmac).

Author: Trent Butcher

Introduction:

In recent years the export hay industry (growers and buyers) has been severely impacted by rainfall post cutting. Growers have adopted shorter season varieties, sown them earlier to achieve high yields which has resulted in the hay crop being cut earlier each season. Earlier cutting slows drying time and also means the hay is on the ground at a time when the probability of rain is higher.

Peter Dowdell estimated that since 2009 80% of the hay in the greater Narrogin area has been downgraded due to rainfall prior to baling. In 2014 he trialed Aladdin oats which are a long season irrigation variety with good rust resistance that can handle heat stress. He planted them on the 27th of April and cut them on the 26th October (2-3 weeks later than most hay). It yielded 6t/ha and made AAA grade.

Project Aims:

This trial seeks to evaluate how yield, quality and economics of long season varieties compare to the traditional shorter season hay varieties (Carrolup, Brusher) with both early and later sowing. This information will provide options to growers so that they can use variety selection to better manage risk.

Methods

The trial was located approximately 10km west of Narrogin in the medium/high rainfall zone. The trial was designed using a near neighbour control style configuration with plots measuring 8.9m x 300m with Carrolup selected as the control variety. Larger 5ha plots of each variety were also grown in the paddock to assess for technical performance (these were all sown on the 26th of May). Seven varieties were selected based upon their season length, the shorter season varieties included, Carrolup Williams and Brusher. The long season varieties included; Tungoo, Genie, Aladdin and Forester. The varieties were sown at two timings, the 28th of April being the first and the 26th of May the second. All plots were sown with commercial rates of fertiliser (table 1). Varieties were cut at the time of flowering which was determined by an industry standard for maximum quality (where possible).

Visual observations, plant counts, yield and hay quality (samples were taken on the day of cutting and at the time of baling) were used as determinants of variety suitability.

Table 1: Fertiliser applied to trial

Products	T or kg/ha	N	P	K	S
Whitboost	116	13.11	14.73	11.60	8.12
Urea	90	41.40			
Urea	32	14.72			
Muriate of Potash	55			27.50	0.39
	293	69.23	14.73	39.10	8.51

Results:

Though Narrogin is in the medium/high rainfall zone this year it suffered from significantly below average growing season rainfall (258mm GRS), the long term average is 409.6mm (figure 1). A sharp end to the season due to a dry spring resulted in many of the longer season varieties not reaching the correct time of maturity at cutting as they were starting to brown out prematurely.

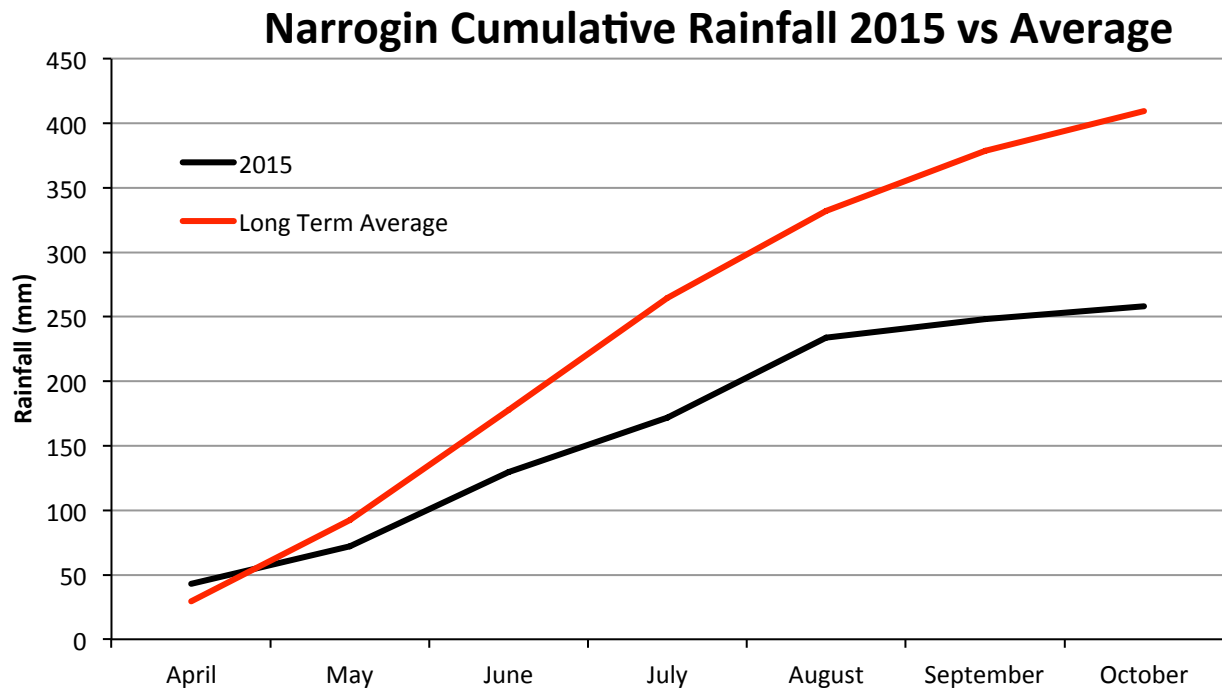


Figure 1: Narrogin cumulative growing season rainfall of the 2015 season vs the long term average.

The sharp end to the season also compromised the cutting time of varieties by causing many of the long season varieties to mature rapidly whilst others tried to run the full course.

Variety Yields at Both Sowing Dates

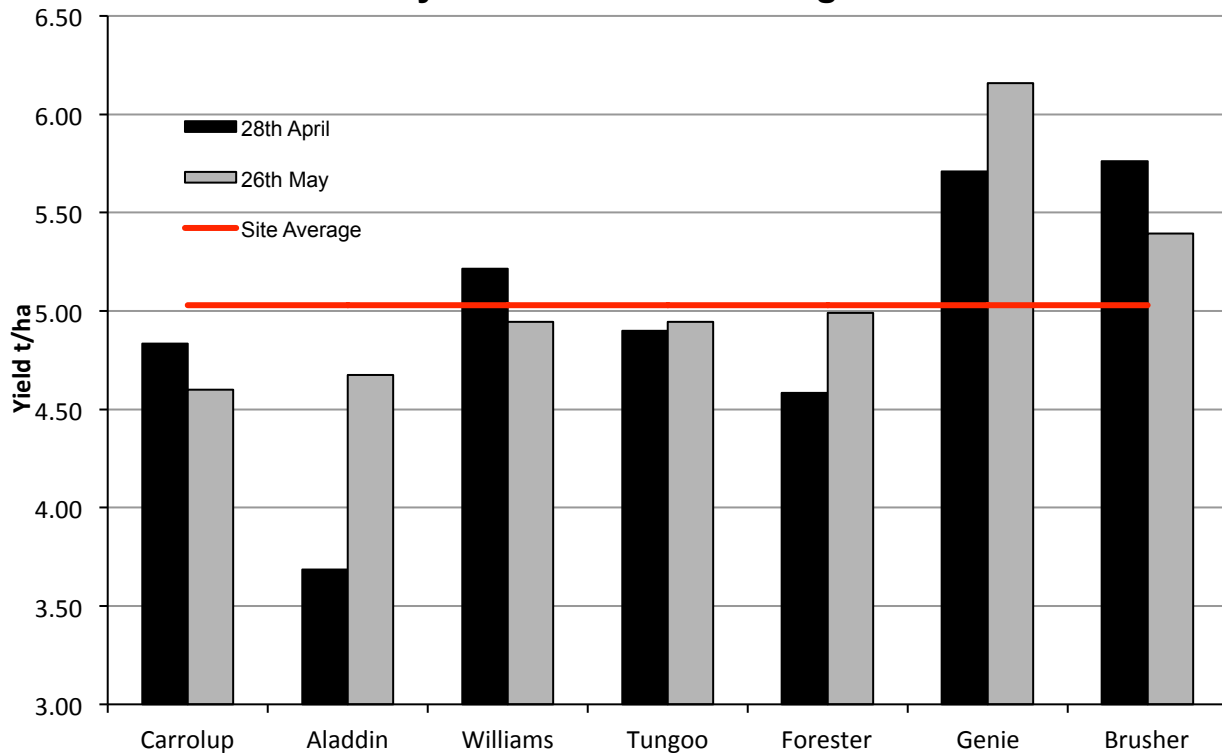


Figure 2: The yields of the seven different varieties at two times of sowing.

The fast end to the season gave an advantage to the earlier sowing times of the shorter season varieties (figure 2). In all cases the earlier time of sowing resulted in a higher yield (5-7%) for the short season varieties than the later time of sowing. Longer season varieties showed the opposite trend with the later sowing in general returning high yields than the early sowing (Tungoo did not follow this trend).

Genie and Brusher at both times of sowing and the early sowing of Williams were the standout varieties with yields that were above the site average (5.03t/ha). Tungoo showed fairly little variation in yield between the two times of sowing (~1%) making it the least sensitive to sowing date. Aladdin's first time of sowing returned a yield much lower than the second time of sowing (21% variation) due to chemical drift. Williams yielded about 7% higher than Carrolup at each time of sowing and Brusher yielded 8-9.5% better than Williams at both times of sowing.

Quality Grading and Economics

Table 1: Feed tests and grading from Gilmac Pty Ltd (green=made top grade, yellow=dropped one grade, orange=dropped two grades, red=dropped 3 grades)

April Sowing							
Paddock	DMD	ADF	NDF	WSC	ME	CP	Payment Grade
Aladdin	67.8	30.5	55.2	22.6	10.1	6.5	OH1QV
Carrolup	70.2	27.9	47.7	34.5	10.5	5.5	OH1QQQV
Williams	68.5	28.5	48.9	30.8	10.2	6.4	OH1QQQV
Tungoo	74.2	25.1	44.6	35.1	11.1	6.9	OH1QQQV
Carrolup	68	29.5	49.2	31.8	10.1	6	OH1QQQV
Forrester	69.7	28.6	51.2	27.2	10.4	5.9	OH1QQQV
Brusher	69.8	27.4	47.8	35.1	10.4	5.2	OH1QQQV
Carrolup	71	27.4	51.8	24.2	9.5	4.9	OH1QQQV
Genie	63.5	33.8	57.1	22.1	9.3	4.8	OH1V
Brusher	67.9	29.5	48.4	37.3	10.1	4	OH1QQQV
May Sowing							
Paddock	DMD	ADF	NDF	WSC	ME	CP	Payment Grade
Aladdin	68.8	31	54.6	19.4	10.2	7.5	OH1QV
Carrolup	65.1	31.7	53.1	24.5	9.6	5.6	OH1QQV
Williams	65.2	31.7	53.7	24.6	9.6	5.5	OH1QQV
Tungoo	65.3	31.2	53	23.7	9.6	6.2	OH1QQV
Carrolup	65.1	31.7	53.1	24.5	9.6	5.6	OH1QQV
Forrester	71.3	28.9	50.8	30	10.7	4.9	OH1QQQV
Brusher	63.8	32.8	55.3	23.5	9.3	5.2	OH1QV
Carrolup	64.4	31.3	51.8	24.2	9.5	4.9	OH1QQV
Genie	66	32.3	56	24.7	9.7	4.8	OH1QV

The price paid for each variety was determined based on the quality parameters from the feed tests of each varieties and the associated pricing structure used by Gilmac Pty Ltd in the 2015 season (appendix table 5). Grade is determined by the poorest performing factor. The shorter season varieties all suffered from a quality drop between the two times of sowing. Carrolup, Williams and Brusher all dropped a grade as a result of time of sowing. The second time of sowing resulted in hay which had Acid and Neutral detergent fibers, which were higher than top grade specifications and as a result were downgraded. The longer season varieties did not follow a trend with Genie's quality improving at the second time of sowing, Tungoo's quality dropping at the second time of sowing and Aladdin and Forester's quality remaining the same. Forester consistently maintained characteristics which place it in the top grade for Hay quality.

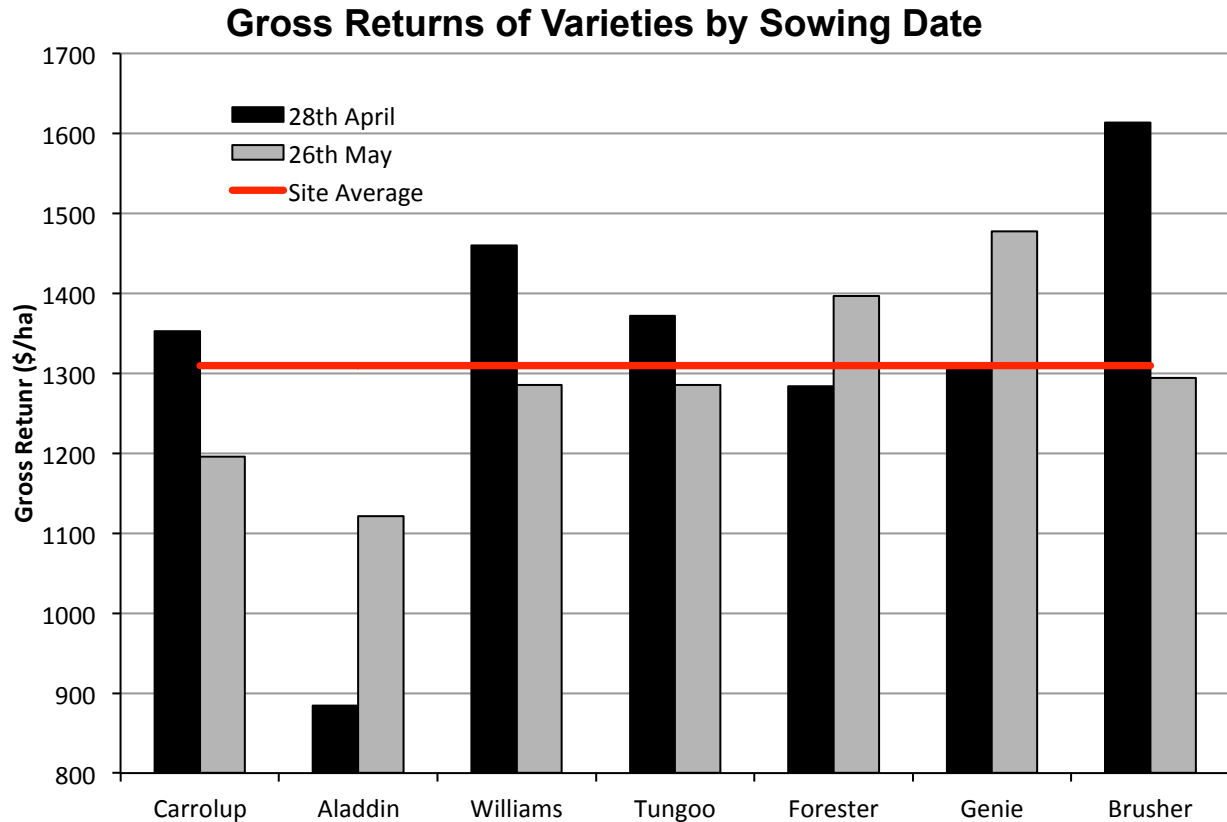


Figure 3: The gross return of the seven different varieties at two times of sowing.

The early sowings of Carrolup, Williams, Tungoo and Brusher all had gross returns which were higher than the site average. The later sowings of these varieties did not give a financial return which was better than the site average. This result can be attributed to improved yield from the earlier time of sowing but more importantly from the consistently better quality hay from the first time of sowing. Genie was a consistent high yielding crop but returned poor quality hay; however the high yield by low price still resulted in a gross margin higher than the site average (May sowing). On the other hand, Forester consistently returned high quality hay which meant that even though it was a relatively low yielder it produced competitive returns, particularly from the May sowing. Aladdin's poor quality and yield resulted in the poorest gross margin of any variety at both times of sowing returning \$188-425 less than the site average.

Discussion

Due to the dry, cutting times were brought forward two to three weeks earlier than normal. Cold and dry events in June/July had an effect on Carrolup, Brusher, Williams, Tungoo and Forester with all varieties showing physical symptoms (leaf tipping). Genie however did not seem to be influenced by the cold events and continued to grow giving it an edge over the other varieties especially after a recovery rain event. The soil at the site was very water repellent and potassium deficient and as a result its water holding capacity was poor (Appendix table 6).

The dry season meant that the long season varieties did not meet their potential and many needed to be cut before they had reached maturity due to rapid browning starting to occur on the stems. In general the sowing rates were sufficient to achieve a stem diameter which was within specifications, random sampling indicated that the second time of sowing for Forester had some issues with stem diameter in excess of 6mm (though <7mm) however this was not identifiable in later quality grading (Appendix table 7). Plant numbers also suggest that stem diameter shouldn't have been an issue at the second time of sowing as the plants density was higher at the second time of sowing of Forester.

A thick germination of bromegrass competed against varieties like Tungoo, Forester, some Carrolup plots and in particular Aladdin which struggled to compete as the season progressed. The presence of bromegrass may have some influence on the feed tests of some of these varieties lowering the quality.

A brief overview of how each of the varieties performed is detailed below:

Carrolup

Carrolup's yield wasn't quite as competitive as Williams and its quality profile followed a similar pattern. Carrolup was the control variety in this trial and indicated that though still a performer at the early time of sowing it doesn't stack up to the performance of Williams and Brusher in terms of net-return due to lower yield. Like Williams and Brusher the early sowing of Carrolup returned a higher yield and better quality hay than the later sowing resulting in a better financial return.

Brusher

Brusher had great early vigour at the first time of sowing and was the obvious standout with all other varieties having fairly similar vigour. The most significant drop in quality between times of sowing was experienced by brusher. Though it was still one the highest yielding varieties in the late time of sowing had low digestible fibers. This result indicates that brusher has been more responsive to the tight finish to the season than other short season varieties. This significant quality drop resulted in a significant loss of profit from brusher compared to an early sowing.

Genie

Grew very vigorously and had a large amount of biomass, as a result genie was the highest yielding variety at the second time of sowing. The hay quality was let down at the April time of sowing due to poor water soluble carbohydrates and digestible fibers which were the worst of any variety in the trial. The hay quality was slightly better at the second time of sowing however, the digestible fibers and water soluble carbohydrates again caused a quality drop. The cutting date was earlier than ideal as the correct maturity was unable to be achieved for the second time of sowing due to the sharp end to the season.

Williams

A good yield from the first time of sowing and good feed test results made Williams one of the best performers for the early sowing category falling short to Brusher due to a lower yield. The quality of Williams followed a similar trend to the other short season varieties with quality dropping with later sowing. One of the criticisms of Williams as a hay variety is that it has thick stems; this characteristic was not present in this trial and is likely not present due to a high seeding rate.

Tungoo

Tungoo was the most consistent performer in terms of yield over the two times of sowing. This didn't follow the normal trend of higher yields at the early time of sowing which was characteristic of other varieties with similar maturity. The growing conditions of the site seemed to be unfavorable to the growth of Tungoo with favorable growth being isolated to small areas within plots. This is indicative that a soil constraint is limiting growth potential. The maturity of Tungoo was fairly similar to that of Brusher, Carrolup and Williams and as a result it followed a characteristic drop in ADF and NDF at the later time of sowing. Tungoo performed better than Carrolup, however it fell short on the performance of Brusher and Williams and gave a poorer return.

Forester

Forester consistently tested up the best, the plants bolted when stressed whereas the other long season varieties tried to run their course. Forester like Aladdin and Tungoo appeared not to like the growing conditions of the site with patchy favorable growth visible in certain areas. Again it's likely that this is caused by a soil constraint. Septoria appears to be an issue in this variety with a significant number of lesions on the leaves. Though it was able to physiologically respond to the season its growth was still characteristic of a long season variety and as such it wasn't able to achieve a competitive biomass. The second time of sowing returned a higher yield than the first time of sowing which was a trend of the long season varieties.

Aladdin

Low Water soluble carbohydrates coupled with high neutral detergent fiber in both sowing times compromised its quality and forced it into the lower grade. The environmental conditions of this season did not suit the growth of Aladdin well as it seemed to struggle with the acidic sand soil as well as the dry and frosty conditions. As a result it was consistently the lowest biomass variety and this led to very poor competition with the bromegrass on the site. The success of the bromegrass within the plots likely contributes to the lower feed scores. Aladdin also failed to reach the correct stage of maturity at the time of cutting due to the dry finish and early senescence. Aladdin appears to have a poor fit on the acidic sands of Western Australia

Conclusions

- Early sowing of Brusher followed by the late sowing of Genie offered the best gross margins (closely followed by the early sowing of Williams).
- Short season varieties benefited significantly from an early planting in both yield and quality
- The dry finish to the season resulted in some long season varieties failing to reach the correct maturity at the time of cutting.
- Genie though the highest yielding variety suffered from poor feed tests likely due to the dry end to the season.
- The prevalence of disease in some varieties coupled with the dry conditions and presence of bromegrass likely compromised the feed tests of affected varieties.
- A more typical season would be better for assessing the true performance of long season varieties.
- Long season varieties need further evaluation as to how they perform in both yield and quality in the Western Australian environment.

Appendix

Table 2: Plant Densities per square metre by plot

	Aladdin	Carrolup	Williams	Tungoo	Carrolup	Forester	Brusher	Carrolup	Genie	Brusher
TOS1	176	182	202	193	197	223	216	156	261	231
TOS2	231	273	256	247	290	290	262	280	253	

Table 3: Cutting and baling dates of each variety and time of sowing

Action undertaken	Date
TOS1 Carrolup, Brusher, Williams, Tungoo cut	20/09/2015
TOS1 Forester TOS2: all cut (long season varieties dying)	06/10/2015
All Trial Plots baled	12/10/2015

Table 4: Grading undertaken by dafwa and gilmac, showing variability in grading systems.

	Dafwa samples		Gilmac samples	
TOS1	Gilmac Payment Grade	DAFWA	DAFWA	Gilmac Payment Grade
Aladdin	OH1V	3	2.0	OH1QV
Forester	OH1QQQV	1	1.0	OH1QQQV
Brusher	OH1QV	3	1.0	OH1QQQV
Carrolup	OH1QV	3	1.0	OH1QQQV
Tungoo	OH1QQQV	1	1.0	OH1QQQV
Genie	OH1V	3	3.0	OH1V
Williams	OH1QQV	2	1.0	OH1QQQV
	Dafwa samples		Gilmac samples	
TOS2	Gilmac Payment Grade	DAFWA	DAFWA	Payment Grade
Aladdin	OH1V	2	2	OH1QV
Brusher	OH1QV	3	3	OH1QV
Carrolup	OHMIN	3	2	OH1QQV
Forester	OH1QQV	2	1	OH1QQQV
Genie	OH1V	3	3	OH1QV
Tungoo	OH1QV	1	2	OH1QQV

Table 5: Gilmac Hay quality parameters by grade.

	DMD	DADF	NDF	WSC	Green	Brown	Weather Damage	Chaff	Aroma	Stem (mm)
OH1QQQV	>60	<30	<52	>23	>70%	<10%	Nil	<25%	Bland	<6
OH1QQQ	>60	<30	<52	>23	>70%	<10%	V. Minor	<25%	Bland	<6
OH1QQV	>60	<32	<54	>20	>50%	<15%	Nil	<25%	Bland	<6
OH1QQ	>60	<32	<54	>20	>50%	<15%	Minor	<25%	Bland	<6
OH1QV	>58	<33	<56	>18	>50%	<20%	Nil	<25%	Bland	<6
OH1V	>56	<36	<59	>12	>50%	<20%	Nil	<25%	Bland	<7
OH1	>56	<36	<59	>12	>30%	<20%	Moderate	<25%	Bland	<7
OHMINV	>54	<39	<64	>6	>30%	<20%	Nil	<25%	Bland	<7
OHMIN	>54	<39	<64	>6	>30%	<25%	Moderate	<25%	Bland	<7

Table 6: Soil Test results

	0-10cm	10-20cm
Soil Texture	1	1
Soil Colour	LTGR	GRWH
Gravel %	5	5
pH (CaCl ₂)	5.9	4.7
EC	0.16	0.024
Alum_CaCl ₂	0.29	5.81
Nitrate Nitrogen	37	7
Ammonium Nitrogen	48	6
Phosphorus	41	30
Potassium	75	26
Sulphur	10	5

Table 7: Stem diameter and Chlorophyll content of each plot (sampled 3 times)

	Variety	SPAD	Stem Diameter										Average
			1	2	3	4	5	6	7	8	9	10	
1	Brusher 1-A	45	6.09	6.49	4.68	5.73	6.2	2.86	5.1	5.38	2.8	4.96	5.029
2	TOS1 Forester 1 of 3	43	7.13	6.37	7.1	5.66	5.98	5.58	3.86	6.63	6.87	7.2	6.238
3	TOS2 Aladdin 2 of 3	43.1	6.1	4	5.08	4.91	5.47	5.84	4.01	4.83	3.33	3.8	4.737
4	TOS2 Forester 3 of 3	48.5	5.89	4.82	5.82	6.84	6.62	6.44	4.26	5.05	6.08	7.31	5.913
5	TOS2 Genie 2 of 3	54.4	6.97	6.24	6.08	4.8	4.57	4.96	6.33	5.38	6.07	5.46	5.686
6	TOS2 Aladdin 1 of 3	50.6	3.79	4.37	4.14	6.03	6.34	5.01	4.32	5.21	3.91	5.03	4.815
7	TOS1 Aladdin 2 of 3	45.6	5.53	4.78	4.72	5.55	6.3	4.21	5.53	6.04	5.17	6.65	5.448
8	TOS1 Forester 2 of 3	49.9	4.24	5.72	4.97	5.63	5.7	4.63	4.14	6.72	5.54	7.52	5.481
9	TOS 1 Aladdin 3 of 3	39.3	5.61	6.43	6.93	4.56	4.25	5.41	6.42	5.75	6.02	5.49	5.687
10	TOS 2 Forester 2 of 3	49.7	7.14	6.39	7.61	5.81	5.24	6.45	6.58	6.75	6.37	3.88	6.222
11	Tungoo 1-C	44.3	6.74	5.06	4.76	4.72	5.97	4.36	4.69	5.72	4.55	4.76	5.133
12	Williams 1-A	50	6.17	4.74	3.4	5.37	7.08	5.64	4.7	7.46	6.52	4.63	5.571
13	Williams 1-B	45	7.64	6.02	5.74	3.25	6.69	5.56	5.61	7.53	3.22	4.35	5.561
14	2 Carrolup A-1	40.3	5.23	4.44	4.28	5.7	5.77	5.05	5.08	5.34	5.91	4.25	5.105
15	Carrolup 3-B	41.5	4.56	5.71	5.63	5.99	4.41	2.87	4.98	4.16	5.22	5.85	4.938
16	Tungoo 1-A	41.1	4.92	5.13	6	5.46	4.76	5.26	5.36	5.78	5.43	4.27	5.237
17	Carrolup 2-A	45.2	5.69	7.35	6.28	5.32	5.19	4.08	5.01	5.11	6.37	4.41	5.481
18	Carrolup 2C	44.5	4.39	5.9	5.27	5.09	4.72	3.76	3.82	5.3	5.16	6.22	4.963
19	Brusher 2-A	53	5.06	4.33	6.2	5.94	5.33	5.61	5.65	5.91	3.74	5.49	5.326
20	Brusher 2-C	43.1	4.86	3.68	5.01	5.04	5.55	4.19	5.4	5.53	6.52	4.11	4.989
21	Brusher 2-B	50.8	6.9	5.78	4.57	5.29	5.51	4.15	6.02	6.15	5.47	4.51	5.435
22	Carrolup 3-c	40.8	5.17	4.19	5.58	4.18	4.72	3.23	4.39	4.55	4.95	4.18	4.514
23	Brusher 1-B	48	4.44	5.6	5.16	4.92	4.46	4.83	5.78	3.77	6.32	4.35	4.963
24	Carrolup 2-B	44.3	3.12	6.07	5	4.19	3.86	4.81	5.76	4.54	5.67	4.9	4.792
25	TOS2 Aladdin 3 of 3	50.4	5.44	6.03	4.58	4.75	3.88	5.98	5.82	4.63	5.86	4.92	5.189
26	Carrolup 1-B	42.9	4.6	4.11	5.86	3.63	5.47	5.19	5.57	5.02	4.98	4.53	4.896
27	TOS2 Genie 3 of 3	47.1	6.55	4.59	4.77	5.24	5.09	7.08	5.68	3.89	5.4	5.44	5.373
28	Williams 1-C	50.7	5.48	6.29	4.93	7.02	6.28	4.76	5.91	6.87	3.57	6.12	5.723
29	Carrolup 1-C	47.8	4.96	4.26	3.93	3.09	3.94	4.94	4.09	6.26	3.06	5.4	4.393
30	Tungoo 1-B	42.9	4.96	3.94	4.67	4.59	5.01	5.35	5.44	3.76	3.93	5.22	4.687
31	Carrolup 1A	43	3.73	5.6	6.05	5.19	5.09	4.59	3.96	5.05	4.88	4.57	4.871
32	Carrolup 3-A	47.5	3.29	3.58	3.59	4.78	5.32	4.86	5.28	3.62	4.54	4	4.286
33	Brusher 1-c	47.1	6.24	5.25	4.91	4.8	4.48	3.56	5.07	5.69	3.97	4.05	4.802
34	Tos2 Genie 1 of 3	49.9	5.84	5.76	5.66	4.91	4.72	5.51	5	5.52	6.41	5.86	5.519
35	Tos 1 Aladdin 1 of 3	42.6	5.62	6.95	4.8	5.27	6.59	4.66	3.37	4.21	4.85	4.53	5.085
36	Tos 1 Forester 3 of 3	49.4	4.93	5.85	5.84	5.63	5.76	4.96	4.08	4.53	5.05	5.45	5.208
37	Tos2 Forester 1 of 3	49	5.83	6.65	5.88	5.91	6.87	5.64	6.26	5.97	5.77	6.52	6.13
38	Brusher 2-B	59.6	5.7	5.72	5.31	4.3	5.39	4.11	5.98	6.27	3.32	5.55	5.165
39	Genie-C	39.5	3.49	5.84	5.61	5.52	4.86	5.24	6.79	6.4	3.66	5.82	5.323
40	Genie-A	47.6	4.67	5.98	5.45	6.22	6.25	5.4	7	4.21	6.11	4.89	5.618
41	Genie-B	40.1	3.78	4.59	5.39	4.7	6.72	5.38	5.73	5.94	6.08	6.06	5.437
42	2 Brusher-A	52.5	4.34	4.13	4.54	4.4	5.21	4.87	4.8	4.48	3.95	4.16	4.488
43	2 carrolup 3-C	47.6	5.18	3.36	5.01	3.15	4.8	5.31	4.18	5.89	5.75	5.19	4.782
44	2 Brusher-C	59.2	5.77	5.89	4.78	5.21	4.28	4.9	4.37	6.11	4.85	5.38	5.154
45	2 Carrolup C-1	38.6	5.04	5.6	6.16	3.6	6.45	5.09	5.19	5.89	5.66	5.8	5.448
46	2 Carrolup c-2	50.2	5.91	5.24	5.68	5.41	6.94	5.14	5.78	4.43	6.46	5.29	5.628
47	2 Tungoo-A	50.1	5.37	7.23	5.32	6.24	7.15	5.37	5.23	3.16	5.36	6.91	5.734
48	2 Carrolup B-1	46.9	6.44	4.78	3.46	5.3	4.69	5.35	5.82	3.38	5.42	5.02	4.966
49	2 Carrolup B-2	46	5.08	3.22	4.94	4.65	4.5	4.19	4.93	4.8	3.53	5.13	4.497
50	2 Tungoo C	49.5	3.78	3.79	4.31	4.36	5.32	4.61	3.71	3.66	4.39	3.65	4.158
51	2 Carrolup A-2	48.5	3.24	3.11	4.32	4.49	3.95	3.77	4.41	3.36	3.98	4.55	3.918
52	2 Tungoo -B	44.4	4.77	5	3.59	5.86	4.17	3.86	4.35	5.54	3.97	3.02	4.413
53	2 Carrolup A2	48.4	4.74	4.83	4.23	4.37	4.7	5.08	4.51	3.87	4.67	5.62	4.662
54	2 Carrolup b3	45.9	5.06	4.96	4.77	4.1	4.8	4.35	4.35	4.34	4.68	4.14	4.555