The Effect of Share Thickness on Wear Life and Tillage Forces

L.B. O'Callaghan, Research Engineer
Agricultural Machinery Research and Design Centre, University of South Australia
Phone: (08)83023946 Fax:(08)83023380

1. INTRODUCTION

With increased demand for greater durability of tillage tools, pressed steel share manufacturers are using progressively thicker material to manufacture their products. The increase in share thickness has been shown to increase share life[1,2] but could have an adverse affect[3] on draft force (directly related to fuel usage) and vertical force (soil penetration). With cast share manufacturers progressively making thinner shares an there is belief that there is a share thickness would result in better share performance.

2. EXPERIMENT

The Agricultural Machinery Research and Design Centre at the University of South Australia is investigating the effect of material thickness on the wear life and tillage forces of pressed steel cultivator shares. Commercially available 150mm wide Agpoint Australia 61U cultivator shares manufactured from K1073 high carbon steel were chosen as the share size and shape for the tests. Shares of 4mm thickness were used as a representation of pressed steel shares of the 1970's, with 6mm being the current production thickness. Shares of 8mm thickness were included as a possible option that the industry may take in the future in order to increase share life.

During 1994-96, the University of South Australia's tillage dynamometer was used to conduct field trials in several soil conditions. Tests were conducted in a dry abrasive red brown earth at Yacka, SA (3.4%WB), wet abrasive red brown earth at Yongala, SA (8%,11.3%,12%WB) and a less-abrasive sandy loam soil at Avon, SA in both dry (3.7%WB) and wet (10.7%WB) conditions.

Wear tests were conducted using 12 John Shearer '580' tines mounted on two ranks at a 230mm share spacing, operating at a speed of 12km/h and a depth of 75mm. Measurements of share mass and shape dimensions were taken at regular distance intervals throughout each experiment. Tip length loss was used as a measure of useful life, with a final tip length of 75mm (nominal 35mm tip length loss) considered as worn out. Force tests were performed under the same soil conditions with one tine mounted in the University of South Australia's Two Force Frame.

3. RESULTS

Figures 1 & 2 show the results from the test at Yongala in wet soil conditions, in which the mass loss and tip length loss over the life of a 4mm share is compared to a 6mm and 8mm share. While the mass loss of an 8mm share was significantly higher than a 6mm share which in turn was higher than a 4mm share, figure 2 shows that the tip of an 8mm share receded significantly slower than a 6mm share and the tip of a 6mm share receded significantly slower than a 4mm share. The 6mm shares produced 25% increase in wear life compared to 4mm shares while 8mm shares increased life by 49%.

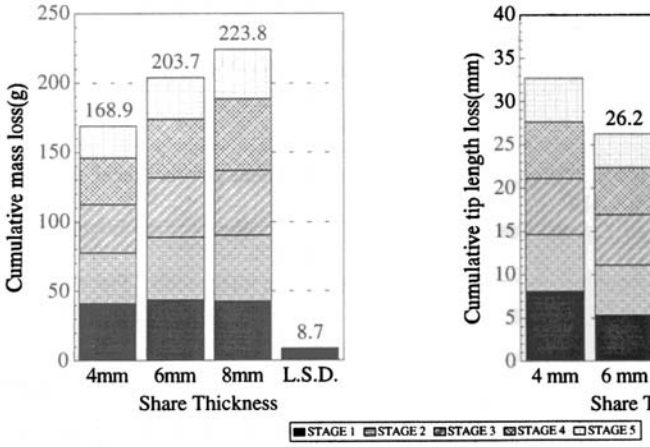

Figure 1. Mass loss vs Share Thickness at Yongala, SA(12%WB)

Figure 2. Tip Length Loss vs Share Thickness at Yongala, SA(12%WB)

Analysis of wear rates compared over the life of a 4mm share shows an average 37% decrease in tip wear rate of 6mm shares. An average 56% decrease in tip wear rate for 8mm shares compared to 6mm shares was also highlighted in the study.
The relative wear life ratios for individual wear tests are presented in Table 1.

Table. 1 Relative wear life

Site	Soil type	Moisture Content (%W.B.)	Relative life ratio* 4mm	6mm	8mm
Yacka (1994)	Red brown earth	3.4	1.0	1.3	1.6
Avon (1994)	Sandy loam	3.7	1.0	1.8	2.6
Yongala (1995)	Red brown earth	12.1	1.0	1.3	1.5
Avon (1995)	Sandy loam	10.7	1.0	1.4	2.0
Yongala (1996)	Red brown earth	11.3	-	1.0	1.3
Yongala (1996)	Red brown earth	8.0	1.0	1.2	-

* Relative tip length life over the life of thinnest share.

Tillage force analysis throughout the life of the shares showed an average draft force increase of 5% when comparing 8mm shares to 4mm shares but in most cases was found not to be significant (p=0.05). Changing from 4mm to 8mm shares resulted in an increase in vertical up forces by up to 160N per tine.

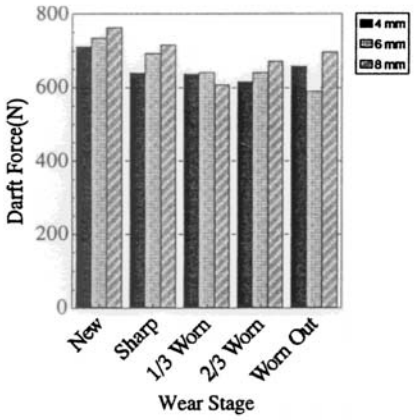

Figure 3. Draft Force vs Wear Stage at Yongala, S.A.(12%WB)

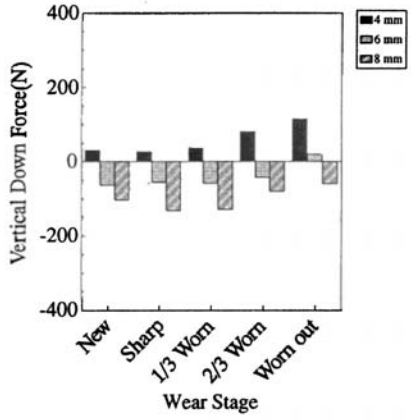

Figure 4. Vertical Force vs Wear Stage at Yongala, S.A.(12%WB)

4. CONCLUSION

From the tests conducted an increase in the thickness of pressed steel shares has resulted in increased wear life. An increase in the share material thickness from 4mm to 8mm has improved share life in the range of 50 -150%, however this will come at the cost of tillage tool penetration ability.

5. REFERENCES

1. Quick, G.R., Woods, C.R., Bartlett, N.R.,(1979). "Effects of speed and other parameters on lineal share wear." Agricultural Engineering Australia. Vol. 8, No.2, 109-117
2. Agricultural Machinery Research and Design Centre, Test. Summary No.1 Share Wear -"The Effect of Share Thickness."(1987)
3. Fielke, J.M., Riley, T.W., Dexter, A.R., (1991). "Cutting edge geometry and the forces on tillage tools." Proceedings of the Conference on Tillage for sustainable crop production, International Soil Tillage Research Organisation, Ibadan, Nigeria.,July 1991.

6. ACKNOWLEDGMENTS

Grains Research and Development Corporation
Agpoint Australia

GRDC
Grains Research & Development Corporation