Effects of Mower Speeds on Vine Pulverization

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Abstract— **A study was conducted to investigate the effects of mower speeds on the resultant pulverized percentage of sweet potato vine (< 28 mm) and lengths of stems at two tractor forward speeds. The results obtained showed that all the treatments were significant at 99 % significance level for the percentage of pulverized vine and the lengths of stems. No significant effects were found for the effects of forward speeds on the lengths of stems. The best results obtained were at a mower speed of 2300 rpm and forward speed at gear 1 which resulted in average values of 95.37 % for the percentage of pulverized vine.**

Keywords: **Mower, Pulverization, Speed, Sweet Potato, Vine.**

I. Introduction

Cutting speed is one of the variables required for a model of cutting mechanics which relate blade parameters to forage material properties for grass cutting [1, 2].

Studies by O'Dogherty [2] showed that a high impact velocity is required, in both laboratory experiments on single stems and field experiments on mowers. Typical speeds employed by disc and rotary mowers are in the range of 71 - 84 m/s.

Results for many studies [3, 4] indicate that all the treatments were significant at $p < 0.01$ significance level for the grass leave area and the lengths of stems. The best results obtained for 2500 rpm and 2700 rpm mower speeds had the best average value of 9.47 and 6.19 cm2 for the leave areas and 15.83 and 17.82 cm for lengths of stems respectively.

Another study by Kakahy et al [5] showed that the best results were at a mower speed of 2500 rpm and 20.37 % of grass moisture content which resulted in average values of 81.03 % for the percentage of leave areas and 82.08 % for the percentage of the lengths of stems. And Kakahy et al [6] results indicated that all the treatments had significant effects at $p < 0.01$ significance level for the percentage of grass leave areas and the percentage of lengths of stems.

Results by Kakahy et al [7] for three different blade angles and three different speeds of a mower blade with serrated edges on pulverizing sweet potato vine, indicated that all the treatments were significant at $p < 0.01$ significance level. The best performance for interaction effect between blade angle and speed of mower was achieved by the 30° blade angle and a mower speed of 1830 rpm resulting in an average percentage of 44.45 % of pulverized vine.

There are requirements for cutting mechanics and for more studies of the cutting action of blades. The data obtained can be used to develop a model which will relate blade parameters to forage material properties [8, 9].

Esmail and Ali [10] found that if range of blade speed to forward speed ratio in cumin mowers is between 0.879 and 44.053 m/s, the stem will be cut with no slipping on the edge.

Results by Chattopadhyay and Pandey [11] for three different forward speeds of the machine (1.6, 4.7 and 7.8 km/h) on specific cutting energy of vertically oriented crop by direct impact in the cutting speed range of 20 - 60 m/s, showed that all the treatments were not statistically significant (5.0% level) at any combinations of cutting speed, bevel angle and rake angle.

II. Materials and Methods

The study was conducted at the Malaysian Agricultural Research and Development Institute, MARDI, Serdang, Selangor, Malaysia, to investigate the effects of two different cutting speeds (2000 and 2300 rpm) and two different tractor forward speeds (gear 1 and gear 2) on sweet potato vine slashing (pulverizing), at 42 % moisture content, wet base (w.b %). Data were analyzed statistically using ANOVA and the least significant difference LSD calculated at 1 % to estimate the differences between the averages.

III. Results and Discussion

Tables 1 and 2 and Figs 1 to 3 indicate that all the

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treatments had significant effects on the percentage of pulverized sweet potato vine passing through the sieve (< 28 mm) at p ‹ 0.01.

The best performance was obtained at a mower speed of 2300 rpm which produced the highest percentage of pulverized sweet potato vine of 80.83 % passing through the sieve (< 28 mm) at p ‹ 0.01. The lowest pulverization percentage of 67.75 % was recorded at a mower speed of 2000 rpm as shown in Figure 1. Meanwhile, forward speed of gear 1 (G1) produced the highest percentage of pulverized vine of 90.17 % and the lowest pulverized vine was at gear 2 (G2) of 58,41 % (Figure 2).

On interaction effect, Table 1 and Figure 2, show that the best performance for effects of interaction between speeds of mower and forward speed was achieved by the second speed at 2300 rpm with first forward speed gear 1 (G1) the highest percentage of pulverized sweet potato vine passing through the sieve (< 28 mm) of 95.37 % at p ‹ 0.01. The lowest percentage pulverization of 50.52 % was achieved by the 2000 rpm with second forward speed of 2300 rpm.

Tables 1 and 3 and Figs 3 to 6 indicate that mower speed had significant effects on the lengths of stems at p ‹ 0.01, meanwhile, there were no significant effects for forward speed and the interaction between cutting speed and forward speed.

The best performance was obtained at a mower speed of 2300 rpm which produced the lowest length of stem of 15.00 cm at p ‹ 0.01 as shown in Figure 4.

Table 1 Analysis of variance (ANOVA) for the pulverized vine and length of stem of the sweet potato.

Source of variation (S.O.V)	Degree of freedom (d.f)	M.S of the pulverized vine	M.S of the length of stem
Replications	2		
Transactions	3		
Speeds of mower (S)	1	513.2592**	456.3333**
Forward speed (G)	1	3026.728**	21.3333n.s
Interactions between (S×G)	1	21.762133**	1.3333n.s
Experimental error	6	0.4578472	20.0833
Total	11		
		L.S.D1%= 1.7364	L.S.D1%= 11.5005

**significant at level 1 %, n.s= not significant, M.S= mean square.

Table 2 Factors influencing the pulverization of the sweet potato vine (%).

S/G	G1	G2	Mean-S
S1	84.98	50.52	67.75
S2	95.37	66.30	80.83
Mean-G	90.17	58.41	

S= speed of mower (rpm), G= forward speed (m/h)

Table 3: Factors influencing the length of stem (cm).

S/G	G1	G2	Mean-S
S1	26.33	28.33	27.33
S2	13.33	16.67	15.00
Mean-G	19.83	22.50	

S= speed of mower (rpm), G= forward speed (m/h)

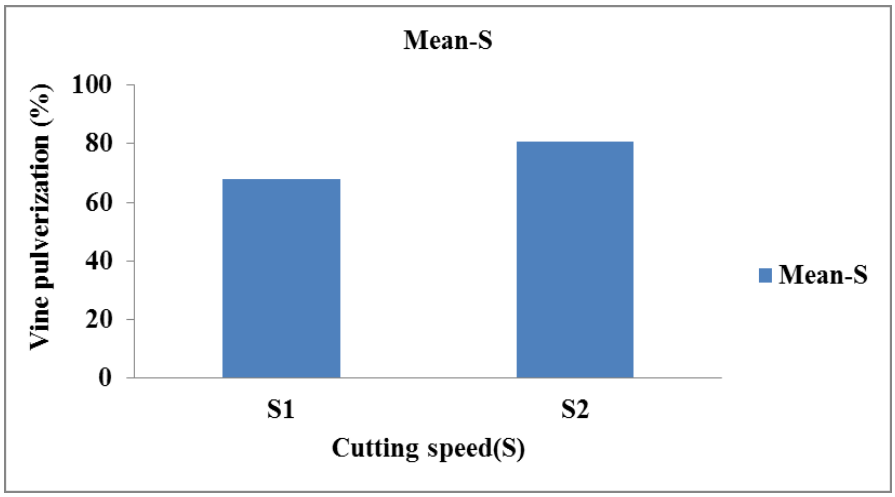

Figure 1 Effects of mower cutting speed on vine pulverization (%)

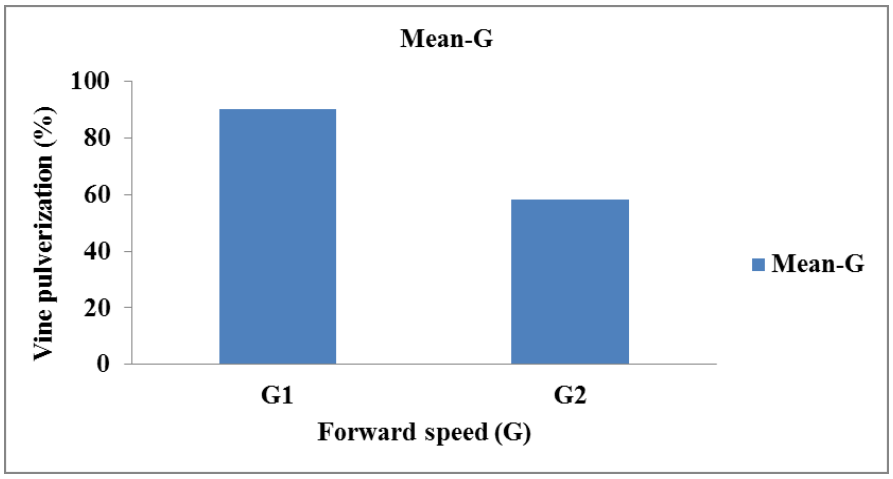

Figure 2 Effects of forward speed on vine pulverization (%).

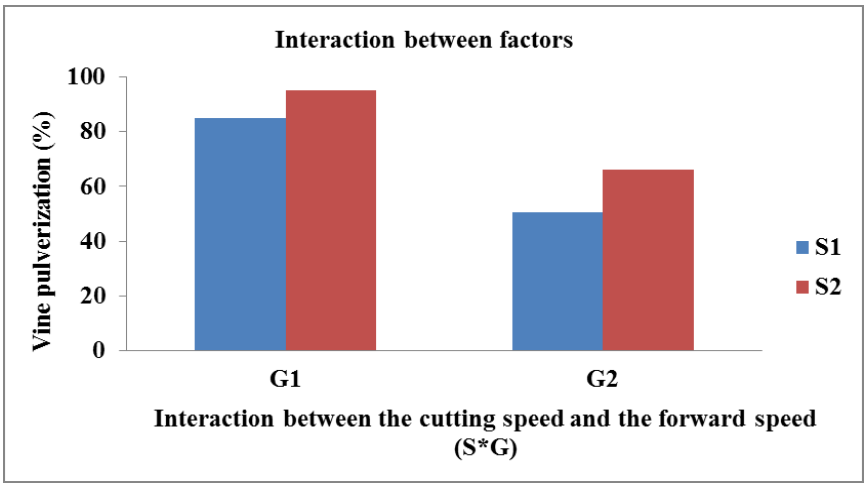

Figure 3 Interactions between cutting speeds and forward speeds on vine pulverization (%).

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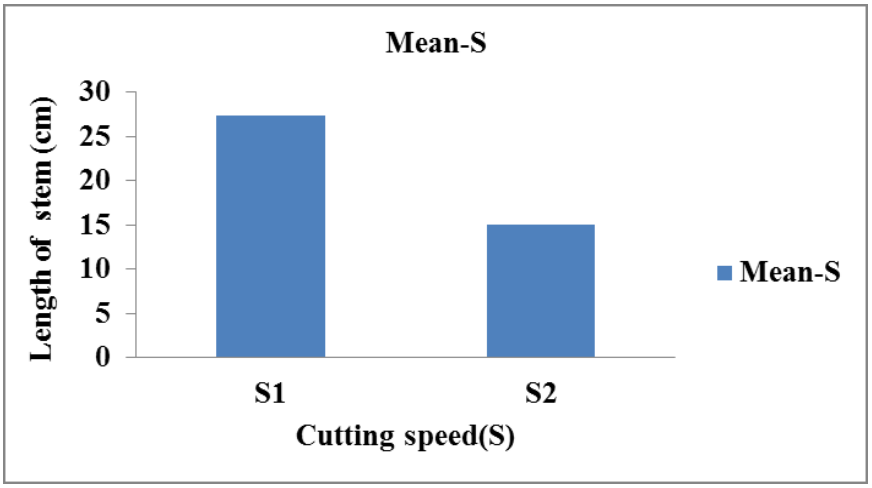

Figure 4 Effects of mower cutting speed on length of stem (cm).

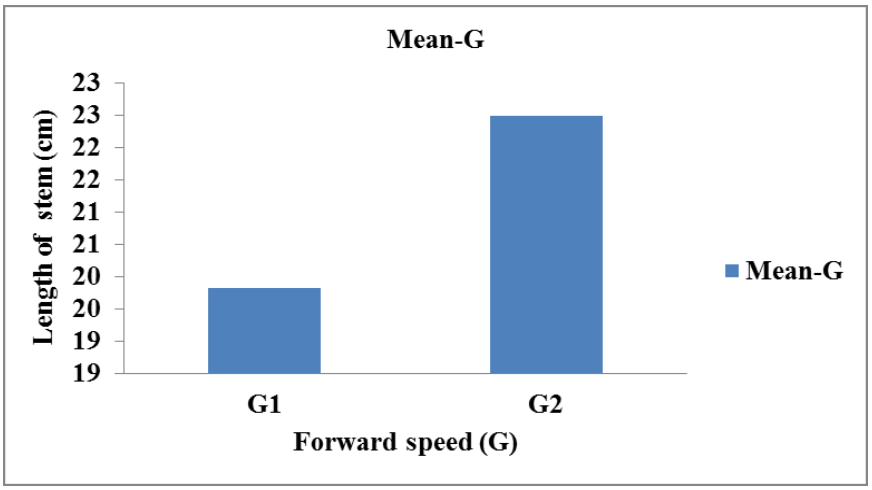

Figure 5 Effects of forward speed on length of stem (cm).

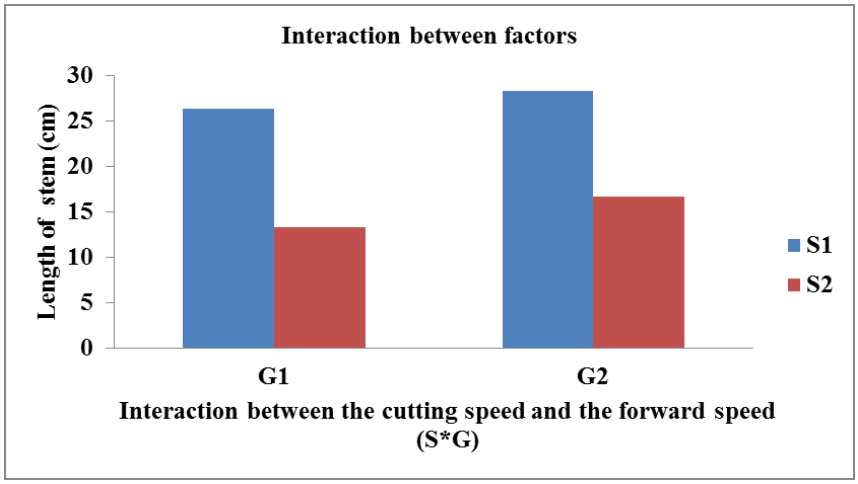

Figure 6 Interactions between cutting speeds and forward speeds on length of stem (cm).

IV. CONCLUSION

The study indicated that the best result was for the low forward speed at high mower cutting speed with highest percentage of pulverized vine and lowest length of stem.

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