MODELLING OF LONG TERM ASPARAGUS PRODUCTION BASED ON FIRST YEAR YIELDS — POSSIBILITIES AND LIMITATIONS

W.T. Bussell[1], Peter G. Falloon[2], and E. Stevenson[3].
[1]Horticultural Research Centre, MAF. Levin
[2]Crop Research Division, DSIR, Christchurch
[3]Applied Mathematics Division, DSIR, Christchurch

ABSTRACT

Ratios of yield in the second and subsequent years to yield in the first year of harvest were calculated for three cultivars — Mary Washington 500W (MW500W), UC157 and Jersey Giant — from eight, long-term cultivar evaluation trials conducted at Levin, Lincoln, Hastings and Ruakura since 1975. The ratios were lower in the open pollinated cultivar MW500W than in the hybrid cultivars UC157 and Jersey Giant. They varied within each cultivar due to both environmental (e.g. rainfall, temperature) and cultural (e.g. length of first harvest season) factors. Better simple models for calculating gross returns by multiplying first year yield by various factors than those currently being used by New Zealand economists were developed from the calculations described in this paper. Their accuracy will depend on environmental and cultural factors, and having as a base the first harvest year yield from a normal length season.

Additional Key Word: Asparagus, open pollinated and hybrid cultivars, yield prediction models, cultural and environmental factors.

INTRODUCTION

When calculating gross returns for an asparagus crop in New Zealand, economists have used the simple model of multiplying first year yield by different factors to obtain an estimate of yield in later years. Their published multipliers have not given an accurate prediction of gross returns in some instances.

We have calculated ratios of yield in the second and subsequent years to first year yield in three cultivars which were grown in all or some of eight long term cultivar evaluation trials conducted since 1975 at Levin, Lincoln, Hastings, and Ruakura. We have investigated whether our data supports the possibility of using a simple model to calculate gross returns, and also considered some of the limitations.

MATERIALS AND METHODS

Yields of saleable, processing grade spears (i.e. straight spears with closed tips and a basal diameter of at least 10 mm when trimmed to 180 mm long) were taken from three cultivars in two trials at Levin Horticultural Research Centre (Levin 1, 2), two at Crop Research Division, Lincoln (Lincoln 1, 2) three at Hastings (Hastings 1, 2, 3) and one at Ruakura. The cultivars were Mary Washington 500W (MW500W), an open pollinated cultivar widely grown in New Zealand since about 1960 which was the control cultivar in all trials, UC157 and Jersey Giant, both higher yielding single cross hybrids at present being widely planted. The design for all trials was a replicated randomised complete block. All had rows spaced 1.5 m apart but the number of replicates and plant population varied between trials (table 1).

The trials were grown in silt loam soils at Levin and Lincoln and in lighter soils at Hastings and Ruakura. Further cultural details and preliminary or final resutls from many trials have already been published (Bussell *et al.*, 1982, 1983, 1985; Falloon and Nikoloff, 1983). The first harvest was made for a short period in the second year after transplanting in all trials. The harvest period extended to the full season in either the third or the fourth year after transplanting. Details of length of harvest in each trial, which are about the normal length for each district, are given in table 2.

Ratios of yield in the second to sixth years to yield in the first harvest year were calculated form all eight trials for MW500W, from five trials for Jersey Giant and four trials for UC157. The possible effects of rainfall, mean air temperature, wind run (obtained from meterological data from Levin HRC, Lincoln, Havelock North and Hamilton Airport), and length of the first harvest season on variability of the ratios were investigated

RESULTS AND DISCUSSION

The ratios of yields in the second to sixth years to yields in the first year in MW500W, Jersey Giant and UC157 are given in table 3. These indicate that multipliers for the lower yielding open pollinated cultivar MW500W are not the same as for the higher yielding cultivars. The multipliers for individual hybrid cultivars are likely to be different, at least in the second and third years. Our ratios show that yield may level off by about the fourth harvest year in MW500W, but later in the hybrid cultivars Jersey Giant and UC157.

TABLE 1: Cultural data in long term asparagus cultivar evaluation trials, and hybrid cultivars harvested in each trial.

Trial	References[a]	Replicates	Plant pop. (000's/ha)	Hybrid Cultivars[b]
Levin 1	1	12	33	—
Levin 2	1,2	10	33	A
Lincoln 1	3	4	67	B
Lincoln 2	4	4	15	A,B
Hastings 1	1	1	22	A
Hastings 2		4	22	A
Hastings 3		2	22	B
Ruakura	4	4	15	A,B

[a] Other published data for trials available as follows:
1 Bussell *et al.* (1981)
2 Bussell *et al.* (1982)
3 Falloon and Nikoloff (1983)
4 Bussell *et al.* (1985)

[b] Hybrid cultivars are
A Jersey Giant
B UC157

TABLE 2: Harvesting data in long term asparagus cultivar evaluation trials.

Trial	Year of 1st harv	No. of days harvested in year 1	2	3	4	5	6	7	8
Levin 1	1976	45	61	80	78	76	78	—	—
Levin 2	1977	30	64	81	76	81	79	85	80
Lincoln 1	1978	40	60	50	66	59	66	74	—
Lincoln 2	1983	40	60	70	—	—	—	—	—
Hastings 1	1977	40	80	80	80	—	—	—	—
Hastings 2	1980	25	42	56	85	86	75	—	—
Hastings 3	1979	25	43	56	71	85	86	75	—
Ruakura	1983	60	84	91	97	97	—	—	—

TABLE 3: Ratios (with standard errors) of yields in the second to sixth years of harvest to first year yields in MW500W, Jersey Giant and UC157. The number of trials that ratios were derived from are given in parenthesis.

Year	Cultivar MW500W	Jersey Giant	UC157
2:1	1.44 ± 0.23 (8)	1.59 ± 0.09 (5)	1.24 ± 0.34 (4)
3:1	2.16 ± 0.46 (8)	2.56 ± 0.61 (5)	2.30 ± 0.77 (4)
4:1	2.36 ± 0.59 (7)	3.31 ± 1.18 (4)	3.43 ± 1.45 (3)
5:1	3.14 ± 0.61 (6)	4.57 ± 1.09 (3)	5.46 ± 3.20 (3)
6:1	2.62 ± 0.48 (5)	5.08 ± 1.57 (2)	3.53 ± 1.83 (2)

The ratios for each cultivar varied considerably (table 3). This was due in part to the small number of trials containing hybrid cultivars, particularly in the later years of harvesting. Variability in the ratios both between trials and within a trial also appeared to be due to both environmental and cultural factors. Ratios in MW500W varied from year to year at Levin HRC and Lincoln (figure 1), due possibly in part to extremes of weather. Rainfall 40% above average between the summer of 1978-79 and spring 1980 would have contributed to low yields and hence low ratios in 1979 and 1980 at Levin HRC. The windier and cooler 'El Nino' summer of 1982-83 may have caused the lower yields in 1983 at both sites. The effect on the ratios of other environmental factors known to affect yield, e.g. soil type (Bussell *et al.*, 1985), could not be assessed due to insufficient data. Other trials at Lincoln (Lincoln 3, 4; figure 2) have demonstrated that a short harvest season in the first year after transplating can give a low base yield and high ratios. A long harvest season for the first harvest can give a high base yield and low ratios. At Levin, for example, a trial harvested for 73 days in its first harvest season (Levin 3, figure 2) had ratios ranging from only 0.86 to 1.03 in later years.

The economists' multipliers (table 4) are generally much higher than the ratios we obtained, especially in earlier years. Some were also higher later, possibly because

TABLE 4: Economists' multipliers used in calculating gross returns.

	Year of Harvest		
	2	3	4
Parminter (1981) for Limbras	2	2.5	2.5
Parminter (1981) for MW500W	2	3.75	3.75
Verberne (1983)	3	7.5	10
McCrone (1986)	2	2.5	2.5

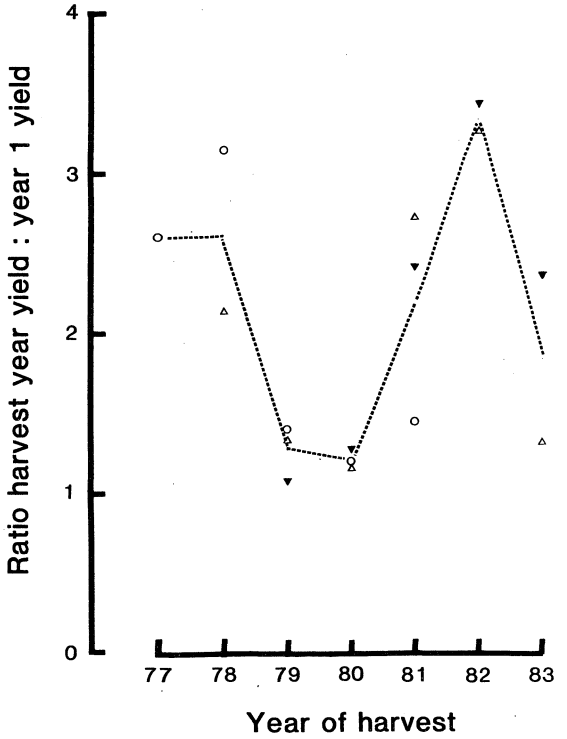

Figure 1: Yield ratios (year of harvest:year 1 yield) in MW500W in trials Levin 1 (○), Levin 2 (△) and Lincoln 1 (▼) between 1977 and 1983. Dotted line joins mean of ratios in each year.

they had poor first year data e.g. yield from a short first harvest year. We suggest that for MW500W first year yield should be multiplied by 1.4 to obtain an estimate of second year yield,, by approximately 2.0 for yield in the third year and by 2.5 for yield in later years. These multipliers may be appropriate for other lower yielding cultivars also. For Jersey Giant, first year yield should be multiplied by 1.6 and 2.6 to obtain an estimate of yield in the second and third years respectively, and by approximately 4.0 for yield in later years. The appropriate multipliers for UC157 are 1.2 and 2.3 for yield in the second and third years respectively, and by approximately 4.0 for yield in later years. Our suggested multipliers should not overestimate

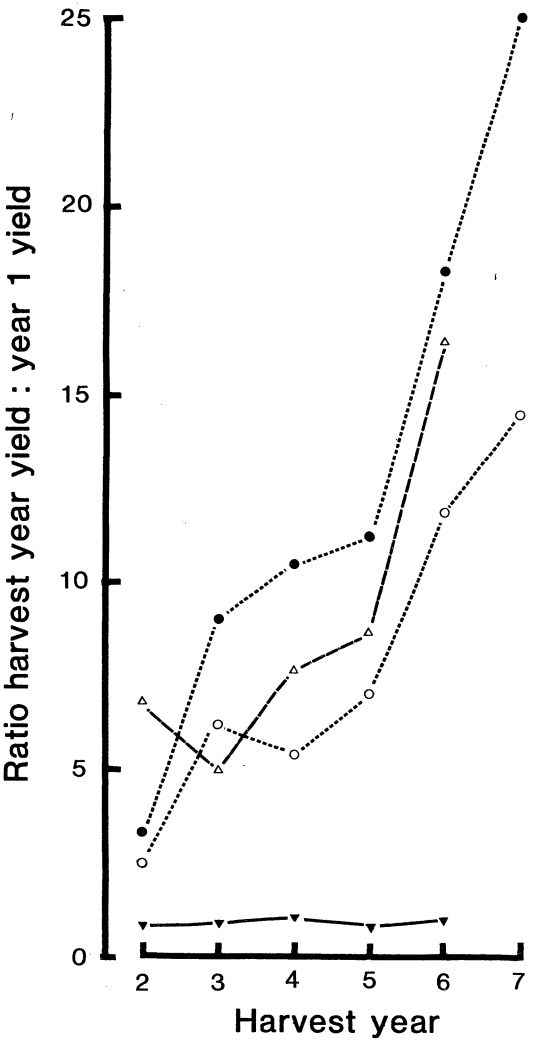

Figure 2: Yield ratios (harvest year:year 1 yield) in MW500W (○) and Jersey Giant (●) in Lincoln trial 3; in MW500W (△) in Lincoln trial 4; and MW500W (▼) in Levin trial 3.

yield in year 5 and later in the hybrid cultivars, particularly if yield has not levelled off by then.

From these data, we suggest that it is possible and reasonable to use the simple model of multiplying first year yield by different factors to obtain an estimate of later yield in an asparagus crop in New Zealand conditions. We consider that there is insufficient known of the effect of environmental factors on variations in yield from year to year, to warrant the use of a more complex model at present. We also consider that a simple model would be widely used by growers and economists. The accuracy of a simple model will always be dependent on cultural and environmental factors, but its accuracy will be improved by having a base yield from a normal length first harvest season.

ACKNOWLEDGEMENTS

Technical assistance by Messrs L.G. Tilbury, B.G. Dobson, M.H. Rhodes, A.S. Nikoloff and D.L. Thomsen during the course of these trials, and permission from J. Wattie Canneries Ltd, Hastings, and Mr S.J. McCormick, Ruakura Agricultural Centre, MAFTech, Hamilton, to use unpublished data are gratefully acknowledged.

REFERENCES

Bussell, W.T., Nikoloff, A.S., Mackintosh, B.L. and Ellison, J.H. 1981. Performance of Rutgers asparagus hybrids in New Zealand. *New Zealand Journal of Experimental Agriculture 9:* 205-207.

Bussell, W.T., Tilbury, L.G., Falloon, P.G., Nikoloff, A.S., Nichols, M.A. and Mackintosh, B.L. 1982. Hybrid asparagus cultivars. *New Zealand Commercial Grower 37(9):* 44.

Bussell, W.T., Nichols, M.A., McCormick, S.J., Alspach, P., Nikoloff, A.S. and Brash, D.W. 1985. Asparagus cultivar evaluation in New Zealand. *Proceedings 6th International Asparagus Symposium, Guelph, Canada:* 52-62.

Falloon, P.G. and Nikoloff, A.S. 1983. Evaluation of asparagus cultivars at Lincoln. *New Zealand Commercial Grower 38:* 36-37.

McCrone, J. 1986 (compiler). Livestock and cropping gross margins, 1986-87 Manawatu. Ministry of Agriculture and Fisheries, Palmerston North, New Zealand. 62 pp.

Parminter, I. 1981. Economics of asparagus production. *Proceedings Asparagus Marketing and Growing Seminar, MAF, Christchurch, June 1981:* 3-17.

Verberne, H. 1983. Economics of asparagus growing, Proceedings Asparagus Growers Short Course, May 1983, Massey University, Palmerston North: 141-149.