



Scientific Aids to blending: A collaborative study
With I.T.L. Canada
(Progress report describing the recent visit to I.T.L.
between the 31st May and 14th June 1980)

G. A. Few

File 1

Circulation

R. M. Gibb, Esq. } I.T.L. Canada
R. S. Wade, Esq. }
Dr L. C. F. Blackman } Millbank ✓
A. L. Heard, Esq.
Dr C. I. Ayres
Dr G. W. Boswall - I.T.L. Canada
Dr R. G. Hook
Dr T. Hirji

109874962

1. INTRODUCTION

In April 1978 Imperial Tobacco Limited (Canada) contacted the GR&DC, Southampton and Millbank requesting assistance in solving the following specific problem. This was one of maintaining smoking quality whilst modifying their current usings mix so as to minimise the usage of grades that are in short supply and maximise the usage of grades in over supply. To facilitate this the Imperial blender, Mr A. P. Schaffer, visited the GR&DC in May 1978 for discussions (1). Following these discussions, it became clear that Imperial felt that grade/ blend matching (2,3) was more suited to the solution of their problem than TPD. With this in mind, Imperial set up a programme of O/WP GC analyses of single grade flue-cured tobaccos from their market for the 1976, 1977 and 1978 crop years with an eye to using this data as a means of maintaining the smoke quality of their blends.

A year following Mr Schaffer's visit to the GR&DC Dr R. G. Hook visited Imperial to put into operation a computer formulation designed to be applicable to the Imperial problem. This consisted of constraints regarding grades for which supply exceeded demand and vice versa so manipulating the usings, appended to a framework which endeavoured to maintain smoking quality. This framework was composed of the O/WP data, and taste and flavour maintenance was affected by minimising a distance measure between that of the O/WP scan from the target grade to be matched and that of the generated blend.

In the year following Dr Hook's visit his original work was supplemented by Judy Fudge, a student on temporary assignment from the University of Waterloo, who was at the same time studying the application of discriminant analysis to the O/WP data, and several written communications were exchanged between GR&DC and Imperial.

109874963

It soon became clear from these communications that the O/WP data from 1977 grades was subject to much larger variability than that observed for the 1976 data, and another visit to Imperial was suggested with the broad objectives of assessing and improving the O/WP data and projecting the study from a paper exercise to a practical experiment in a systematic fashion. With these objectives in mind a visit was arranged to Imperial Tobacco Limited in Montreal between 31st May and 14th June this year.

2. SPECIFIC OBJECTIVES

Shortly following arrival, from a discussion with members of Imperial Tobacco's Leaf blending and R&D staff, it was apparent that the wish of the GR&DC to now take the study from that of being purely one on paper and turn it into a practical exercise completely agreed with the direction in which Imperial were themselves progressing. They had, in fact, produced cigarette samples from three computer derived blends (which were subjectively assessed during the stay) which were matches for GCl from the 1977 crop year.

It was pointed out early in the discussion that progress must follow in a systematic fashion and the following scheme was proposed.

1. Select a target grade to be matched from a defined number of grades.
2. Produce the 'best' match for that grade using the distance measure.
3. Make cigarettes from the blend recipe and compare subjectively with the target grade.
4. If this is an acceptable match go onto investigate how taste and flavour varies with distance measure.

109374964

It was also pointed out that if there is not an acceptable match from 3. one might consider mismatching parts of the scan whilst improving the match in other parts in a systematic fashion until a satisfactory subjective match is obtained.

The meeting concluded with all parties satisfied with the above scheme.

3. REVIEW OF WORK ACCOMPLISHED

The first couple of days were spent scrutinising the O/WP data from 1976 and 1977 grades ensuring compatibility between scans from within crop years and across crop years. I confirmed that a number of inconsistencies existed between scans for grades from the 1977 crop year. These were brought about by baseline errors and peak resolution problems and were duly pointed out to the O/WP analysts.

Consideration of the time required to correct the peak areas in the 1977 data where the inconsistencies lay, indicated that it would be out of the question to edit the data and make significant progress in the specific objectives, outlined previously, during the time allotted to the visit. Hence, it was decided to identify and use only those peaks in the distance measure which were compatible throughout the analyses of the 1977 grades and compatible with analyses from the 1976 crop year. The distance measure was defined as the summation of the absolute error of the blend peak from the target peak over 46 chosen peaks.

Having scrutinised the 1976 and 1977 data and decided which distance measure was to be minimised, Dr Boswall and myself spent the next few days modifying the computer files to include the distance measure and re-running jobs run previously to verify that the computer was producing the same results as before. Having regenerated

109874965

earlier results the computer was asked to minimise the distance measure for 4 target grades given below. At the same time the distance measure over all 105 peaks was retained as a guide.

H2X in 1976 using 12* 1976 grades

H2X in 1977 using 12* 1977 grades

GC1 in 1976 using 8[‡] 1976 grades

GC1 in 1977 using 8[‡] 1977 grades.

* FSC3, GC1, D2, H2, FS3, GC2, RH2X, RGC1, AF3, AF2, BFL, CL

‡ DC2, AFX, CLX, H2X, CL, BF3, H2, AF2

The recipes obtained from these experiments are given in Tables 1 and 2 for H2X and GC1 respectively. Two features are readily apparent in the Tables. Firstly, the distance measures for 1977 matches are larger than those from 1976. This is because the O/WP data from the 1977 crop year is more variable than that from 1976. Secondly, considerable difference is observed in the recipes obtained for the same target between the two crop years!

By the beginning of the second week the hand blending and hand making of cigarettes had begun. This had to be performed quickly since only a few smoking sessions by the expert panel were available and was a co-operative effort between myself and the R&D department. Initially, one of the targets was hand produced (using tobacco from machine made cigarettes) and smoked by the panel and myself against its machine equivalent, each cigarette having a low efficiency filter. Since no significant difference in taste and flavour was found, it was decided to use machine manufactured cigarettes as the target controls. This saved considerable time. Next, the 4 blends given in Tables 1 and 2 were hand blended (again using tobaccos from machine made cigarettes) and the cigarettes made from each blend by hand. Each blend was then smoked by the

109874966

expert panel and myself against the target, again each cigarette had a low efficiency filter.

The comments of the panel were very favourable. Although some differences in smoke intensity were apparent, the panel agreed that for all targets except H2X 1976 the blends showed similar top and base notes i.e. similar taste and flavour characteristics. The blend for H2X 1976, although having similar base notes, had an extra top note which produced the taste difference.

Having been encouraged by the comments of the panel, the next experiment which was planned investigated how taste and flavour varied when the distance measure was varied from 'best' to 'worst' for a target. Since little time now remained it was difficult to produce a good experimental design, however choosing recipes for blends which had already been made into cigarettes allowed GC1 1977 to be compared with a selection of blends/single grades ranging from the largest value of the distance measure (the 'worst' match) to the smallest (the 'best' match). The blend compositions and distance measures are given in Table 3. Notice that the 'best' match obtained in the previous experiment (from a grade pool which did not contain GC3) was not used since this had already been shown to be a close match.

After producing hand made cigarettes for the blend with the lowest distance measure in Table 3, the expert panel and myself smoked the cigarettes as paired comparisons i.e. each blend/single grade against the target, and again each cigarette had a low efficiency filter. The panel agreed that both single grades were good taste and flavour matches for the target. However, CBM2 and the blend with the lowest distance measure differed from the target in taste

109874967

with the latter being quite distinct. Hence, the overall conclusion from the subjective experiments which had been performed was that there does not appear to be a relationship between taste and flavour and the distance measures.

Following a presentation of the results obtained to date to Messrs R. M. Gibb, S. M. Candlish, R. S. Wade, A. P. Schaffer and several other members of the Leaf Department and R&D on the afternoon of 12th June, the remaining time was primarily spent scrutinising the O/WP data from the 1978 grades for within crop year and across crop year compatibility and applying discriminant analysis to the O/WP 1977 data. The discriminant analysis grouped the grades from that year as to stalk position and ripeness in the same way that they would be grouped by the Imperial Leaf Department. The reason for this exercise will become clear in the final section. In conclusion a final blending experiment was performed. From Table 1 the blend recipe for 1976 was applied to 1977 grades and vice versa. Again blending and cigarette making were performed quickly by hand. Unfortunately, time had run out for the expert panel and only one member from the panel, a volunteer and myself assessed the cigarettes. Two pairs were smoked: 1 H2X 1976 versus blend of 1976 grades using 1977 recipe.

2 H2X 1977 versus blend of 1977 grades using 1976 recipe, and the panel found that with the exception of H2X 1977 the other three cigarettes were similar in taste and flavour although the intensity of smoke was quite low from each. H2X 1977 appeared to be a much stronger cigarette.

This concluded the experiments performed in the two weeks.

109874968

4. CONCLUSIONS

The first conclusion to be reached was that more subjective experiments of the type demonstrated during the visit should be performed. It was particularly pointed out by the author and Mr Candlish that differences may have arisen because of the use of hand made cigarettes and it was certainly advised that further experiments with hand made cigarettes be performed at a much slower pace. Although machine made samples would certainly be ideal, problems with the quantities of tobacco remaining in stock and the time factors involved in production would probably exclude the use of machine made samples.

In the event that the distance measures explored so far are shown to be an inadequate reflection of taste and flavour, the question was discussed as to 'Where do we go next?' My feeling certainly, is that there is a lot more to be obtained using O/WP in grade matching than has yet been explored. Although other approaches (involving tobacco chemistry) for controlling taste and flavour of blends were discussed, it is evident that Imperial is enthusiastic in continuing the grade matching project based on O/WP data. Depending on the adequacy of O/WP data to achieve blend matching it may of course be necessary to augment it by including elements of leaf chemistry and physical properties in the ultimate blend matching model.

One point to emerge from the work and from the discussions is that the blending grid used by Imperial blenders whose axes are stalk position and ripeness (see Figure 1) is accepted as generally defining the way in which grades smoke. For instance, GCl and CLX are both cutter/leaf, mature grades. Now, although the computer

109874969

indicated that the O/WP traces were dissimilar, blenders would expect the two to smoke similarly, and, in fact, this was found by the panel to be the case. It was pointed out that if the grid can be used as a loose taste and flavour framework, then if discriminant analysis is applied to separate the groups of grades on the grid using sound O/WP peaks then perhaps these peaks may be used as a distance measure in grade matching. Certainly, there is no problem in separating the groups on the grid on the peaks available.

Since Imperial have already performed a considerable amount of discriminant analysis, it seems appealing to link this into the grade matching programme. Dr Boswall is quite happy to move in that direction on the confirmation that the present distance measures are inadequate and has a student with him at present until August who would be able to take this up as his project.

Since time is short, and enthusiasm high, I feel this would be a ripe time to advance this joint project further by offering as much guidance and technical assistance as we can.

Acknowledgement

I would like to thank everybody at Imperial Tobacco Limited for their co-operation, especially Dr Graeme Boswall, and for making my stay so pleasant.

References

1. File note on file 1 from Dr T. Hirji 2.6.78.
2. BAT report RD 1503 Restricted 14.7.77.
3. BAT report RD 1603 Restricted 17.7.78.

109874970

TABLE 1
TARGET H2X

YEAR	DISTANCE MEASURE OVER 46 PEAKS	DISTANCE MEASURE OVER ALL PEAKS	GRADES (%)											
			CL	FSC3	GC1	D2	H2	FS3	GC2	RH2X	RGC1	AF3	AF2	BFL
1976	41.6	80.3	11.3	1.7	15.2	58.2	-	-	-	8.2	5.4	-	-	-
1977	96.6	186.3	23.5	49.7	-	3.5	13.1	0.7	-	9.4	-	-	-	-

109874971

TABLE 2

TARGET GCl

YEAR	DISTANCE MEASURE OVER 46 PEAKS	DISTANCE MEASURE OVER ALL PEAKS	GRADES (%)							
			DC2	AFX	CLX	H2X	CL	BF3*	H2	AF2
1976	96.2	128.9	-	-	-	54.5	-	2.5	9.4	33.6
1977	108.4	194.0	-	-	-	-	12.2	35.0	52.8	-

* unavailable for 1976 at the time of hand blending and hence was deleted from the recipe.

109874972

TABLE 3

TARGET GC1 1977

CODE	DISTANCE MEASURE OVER 46 PEAKS	DISTANCE MEASURE OVER ALL PEAKS	GRADES (%)								
			H2X	H2	DC2	CLX	CL	GC3	AFX	AF2	BF3
	481.7	752.6	-	-	-	100	-	-	-	-	-
	386.8	623.0	-	-	-	-	-	-	100	-	-
CBM2	*	202.2		63.7				31.7		4.6	
	105.7	192.9		49.4			10.1	12.7			27.7

* Not recorded.

109874973

FIGURE 1. Classification of Flue-Cured Tobacco Grades

	Degree of Maturity						
	1 USA Grades	2 Highest Maturity	3 Mature Unblemished	4 Medium Mature Unblemished	5 Trashy to Coarse	6 Green	7 Very Trashy to Crude
1. Lug			13 DX D2X	14 D D2	15 X2 FS2 FS3		17 FS4
2. Cutter		22 RH2X	23 HX H2X	24 H H2	25 DC2 FSC2 FSC3	26 FBL	
3. Cutter/Leaf		32 RGC1	33 CLX GC1	34 CL	35 GC2 GC3	36 GC4	
4. Leaf	41 MIW	42 RAF3	43 AFX AF3	44 AF AF2			
5. Tip		52 RBF3	53 BF3 G3	54 BF2 CF2 CF2A	55 G2D I8X	56 CF CF2G	57 G4G G4D
	Experimental Grades and Blends (oo)		OF4 QCB QFB MB1 MB2 M1E	Q1 Q2 Q3 Q4 Q5 Q6			

109874974