RESULTS OF INVESTIGATIONS INTO NOZZLE DISTRIBUTION PATTERN WITH REFERENCE TO GROUND APPLICATION OF A SUGARCANE RIPENER

By J. G. HARDY

Triomf Farmers Organisation (Pty) Ltd.

Abstract

Increasing interest is being shown in the use of ripeners in the sugar industry and there is scope for ground applicators because of topography and because relatively small areas need to be sprayed at one time. Investigations into the variables affecting spray distribution patterns for ground applicators are described in this paper. Various standards are recommended.

Introduction

The use of sugarcane ripeners has so far been limited mostly to large irrigated sugar farms in the Zululand/Pongola area, Eastern Transvaal Lowveld and Swaziland. Areas north of the Republic of South Africa where sugarcane ripeners have been used on a large scale include Malawi. Most of these areas are treated by aerial application.

The use of sugarcane ripeners has been limited because "Ethrel", the chemical mostly used so far, can only be used on immature cane of low juice purity (not higher than 70-75%). Also, good responses can only be expected when this ripener is used during the incline phase of the sucrose curve, from April to July.

The recent registration of another sugarcane ripener, "Polado", has caused interest in ripeners to increase throughout the sugar industry. "Polado" can be used under a wide range of conditions. It can be applied to mature cane (90% juice purity) under dryland conditions, and during both the incline and decline phases of the sucrose curve, with good expectations of economic responses. Extensive field experimentation has been carried out on "Ethrel" by Rostron[1] and on "Polado" by Clowes[2, 3].

On a fairly large part of the sugar industry, conventional aerial application of ripeners cannot be practised because of topography or because farm units are relatively small. In such areas only ground applications may be feasible. A few applicators for applying ripeners from the ground have been developed. They consist basically of a knapsack connected to an overhead boom from which the chemical can be sprayed onto the crop canopy.

Because of the difficulties associated with ground application, such as the opening up of cane interrows to allow the operator to walk through the field, the objective should be to cover as wide a swath as possible.

The work described in this paper was done to determine the best method of obtaining an acceptable spray distribution across the swath to be used.

Materials and Methods

The variables which were assessed during this investigation included :

(i) *Nozzle Type.* Flood jet nozzles (TK type) and 110° flat spray nozzles (Spraying Systems) were used. Three sizes of each were tested (TK .75 and 110015, TK 1 and 11002, TK 1.5 and 11003). These pairs of flood jets and flat spray jets have similar outputs. The nozzles were used with the recommended sieves.

(ii) *Nozzle placement.* The flood jets were tested in two positions — facing vertically upwards and vertically downwards. The flat spray jets were placed to spray horizontally.

(iii) *Nozzle pressure.* Three pressures were used (100 kPa, 150 kPa, 200 kPa).

(iv) *Nozzle height above target.* Three heights were tested (220 mm, 500 mm and 750 mm).

(v) *Effective swath.* The two swaths chosen (4,8 m and 6,0 m) suited a wide range of row spacings (Tables 1 and 2).

TABLE 1

Row spacings in relation to a 4,8 m effective spray swath

Row spacing (m)	No. of cane rows per spray swath	Width required to be sprayed (m)	Width sprayed %
1,00	5	5,00	96
1,05	5	5,25	91
1,10	5	5,50	87
1,15	4	4,60	104
1,20	4	4,80	100
1,25	4	5,00	96
1,30	4	5,20	92
1,35	4	5,40	89
1,40	4	5,60	86
1,45	4	5,80	83
1,50	3	4,50	107

TABLE 2

Row spacings in relation to a 6,0 m effective spray swath

Row spacing (m)	No. of cane rows per spray swath	Width required to be sprayed (m)	Width sprayed %
1,00	6	6,00	100
1,05	6	6,30	95
1,10	6	6,60	91
1,15	5	5,75	104
1,20	5	6,00	100
1,25	5	6,25	96
1,30	5	6,50	92
1,35	5	6,75	89
1,40	5	7,00	86
1,45	4	5,80	103
1,50	4	6,00	100

(vi) *Nozzle spacing.* Different nozzle spacings were tested in order to achieve acceptable spray distributions across the required swaths. Spray distribution was assessed by means of a patternator which consisted of 34 compartments, each 100 mm wide, giving a total width of 3,4 m. The spray solution consisted of water and a surfactant (0,02% vol/vol), the amount for each compartment being collected into a 1*l* measuring cylinder. A tractor-mounted sprayer was used to pressurise the system.

A computer fitted with a plotter was used to study the effects of combinations of the variables.

The sequence of operations was as follows:

(i) Assess the distribution pattern for a particular nozzle at various pressures, using the patternator, with the nozzle held 500 mm above the target.

(ii) Test the data by means of the computer, calculating the CV% for individual nozzle and pressure combinations at different nozzle spacings, from 0,8 m to 3,0 m at 0,1 m intervals. The following criteria were used in evaluating the results.

CV greater than 20%	= Unacceptable distribution
CV 11—20%	= Acceptable distribution
CV 9—11%	= Even distribution
CV less than 9%	= Very even distribution

(iii) Select on the basis of these results nozzle spacings for actual testing on the patternator, for each of the two suggested working swaths.

(iv) Assess the effects of nozzle height above target, also using the patternator.

Results and Discussions

The following points of interest became apparent during the investigation:

(i) The use of a surfactant in the spray solution is essential for a good distribution pattern. (See Figure 1).

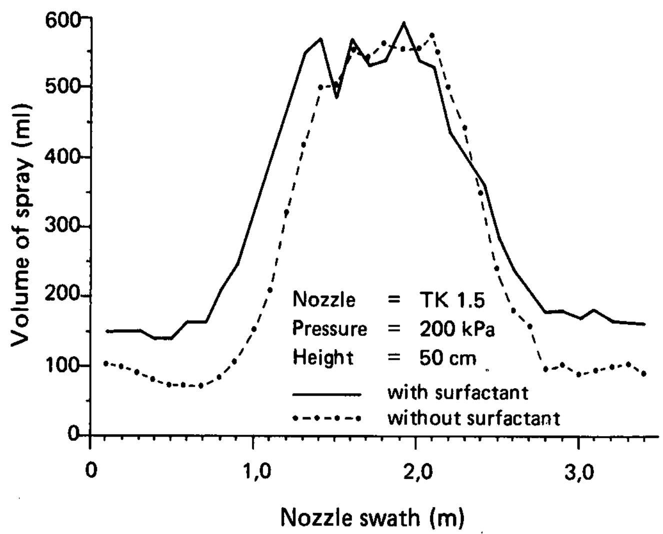

FIGURE 1 Effect of surfactant on spray distribution pattern.

(ii) Increase in nozzle pressure from 100 kPa to 200 kPa resulted in an improved spray distribution pattern, allowing for a wider range of acceptable nozzle spacings. It is not advisable to use any of the nozzles tested at pressure below 150 kPa (See Figure 2).

(iii) 110° flat spray nozzles are not satisfactory, as the acceptable nozzle spacings are very much narrower than those for flood jet nozzles. (See Figure 3).

(iv) The various sizes of flood jet nozzles tested did not behave very differently as far as distribution pattern and swaths were concerned when the spraying pressure was kept above 150 kPa. (See Figure 4).

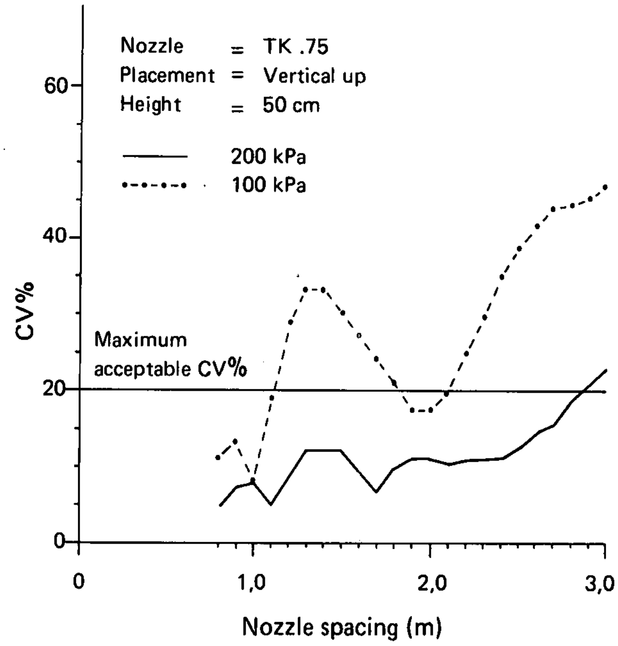

FIGURE 2 Effect of pressure on range of acceptable nozzle spacings.

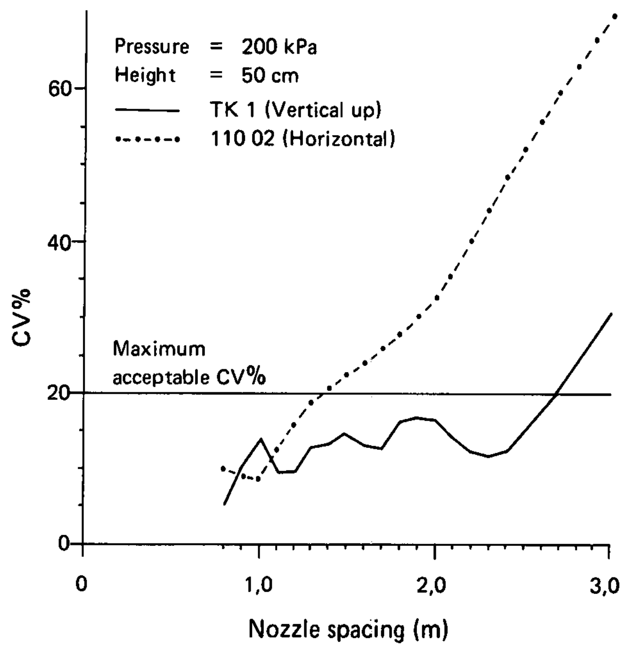

FIGURE 3 110° flat spray nozzle vs TK flood jet nozzle with reference to range of acceptable nozzle spacing.

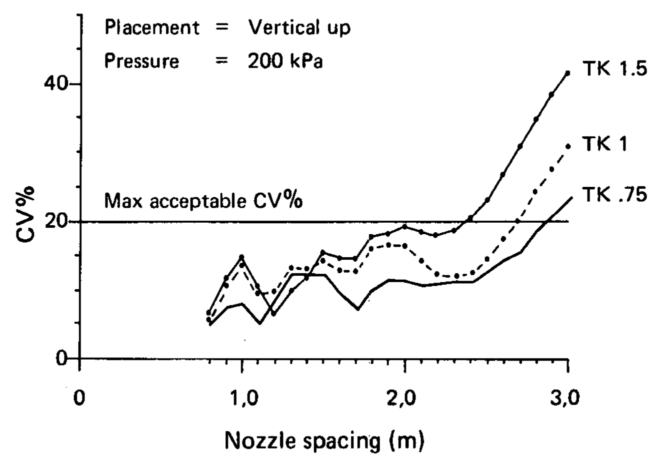

FIGURE 4 Effect of nozzle size on range of acceptable nozzle spacing.

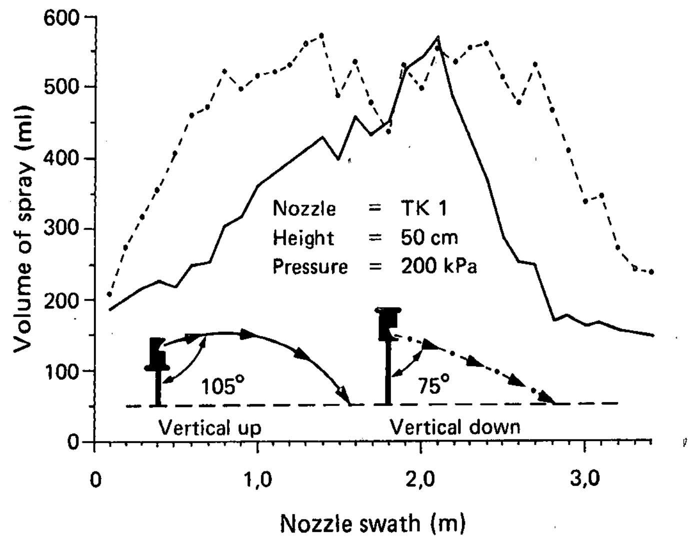

FIGURE 5 Effect of nozzle placement on spray distribution pattern as indicated by patternator results.

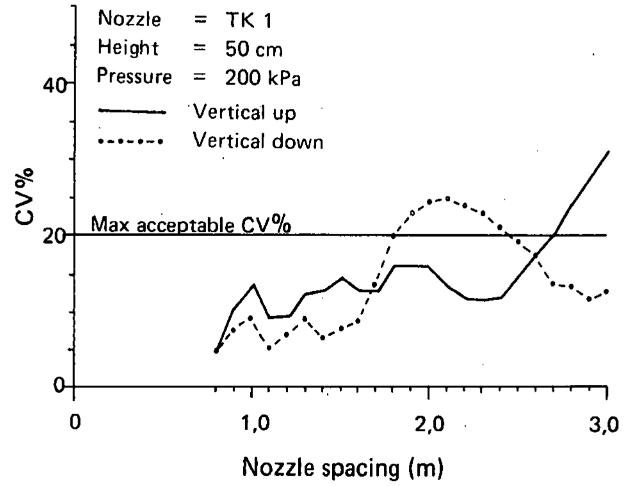

FIGURE 6 Effect of nozzle placement on range of acceptable row spacing as indicated by percentage CV.

(v) Flood jet nozzles must only be used facing vertically upwards. (See Figures 5 and 6).

(vi) Of the four nozzle spacings tested with flood jet nozzles (1,6 m; 2,0 m; 2,4 m and 3,0 m), the optimum spacings were found to be 1,6 m and 3, m. At these nozzle spacings, variation in nozzle height above target from 220 mm to 750 mm did not have an adverse effect on the spray distribution pattern across the swath tested. (See Figures 7 and 8).

Conclusions

The results indicate that some standards should be used when applying a ripener by means of a knapsack and boom.

1. The boom should be fitted with TK flood jet nozzles spaced 1,6 m or 3,0 m apart, depending on the practical spray swath desired. The nozzles should be placed vertically upwards. The maximum recommended swath is 6,0 m and nozzle pressure should not be below 150 kPa.
2. The height of the boom above the average cane canopy height should be approximately 500 mm.
3. The choice of nozzle size and pressure combination will depend on (i) operator's walking speed and (ii) volume required per hectare. (It is recommended that the volume of spray solution be within the range 60 — 120

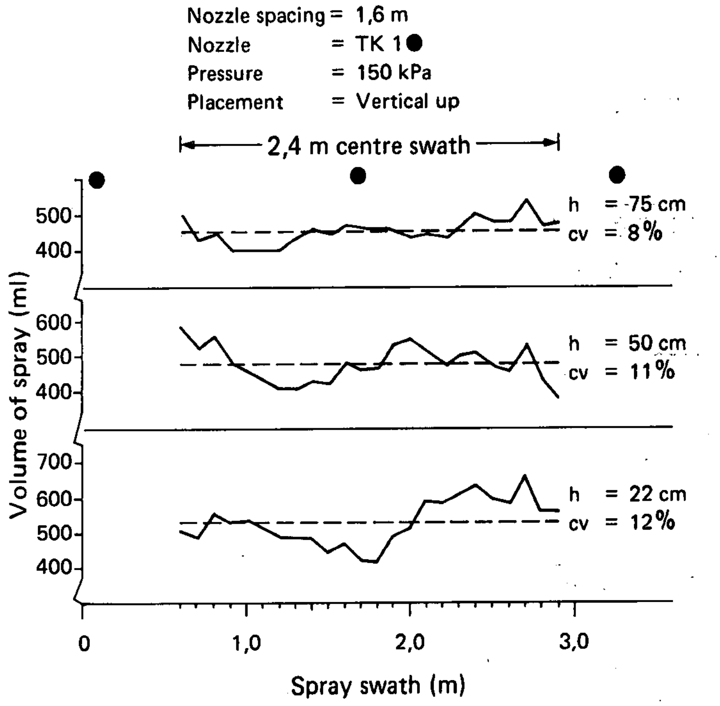

FIGURE 7 Spray distribution (CV%) vs nozzle height for 1,6 m nozzle spacing.

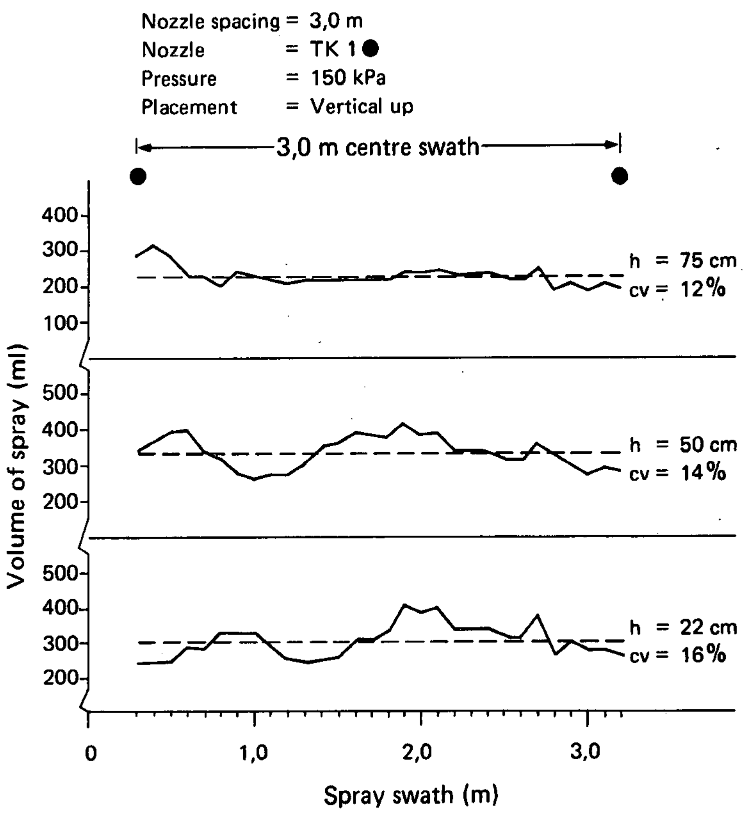

FIGURE 8 Spray distribution (CV%) vs nozzle height for 3,0 m nozzle spacing.

l/ha). Tables 3 and 4 can be used as a guide for effective spray swaths of 4,8 m and 6 m respectively.

4. A factor to be considered is the pressure at the nozzle in relation to the gauge pressure at the knapsack. Table 5 can be used as a guide for compensating loss in pressure for varying boom height.
5. It is important that the equipment be constructed so that the boom can be tilted on hill slopes. Under these conditions the spraying pressure should not be less than 200 kPa in order to minimise variation in nozzle output between the nozzles at the extremities of the boom.

TABLE 3
Nozzle size and pressure in relation to volume/ha for various walking speeds (for 4,8 m effective swath)

Nozzle size	Nozzle spacing	Pressure at nozzle (kPa)	Total volume/min	Volume/ha at walking speed of:		
				0,5 m/sec	0,75 m/sec	1,0 m/sec
TK .75 (with 100 mesh sieve)	3 × 1,6 m	200	1,44 ℓ	100	67	50
TK 1 (with 50 mesh sieve)	3 × 1,6 m	150	1,68 ℓ	117	78	58
		200	1,92 ℓ	133	89	67

TABLE 4
Nozzle size and pressure in relation to volume/ha for various walking speeds (for 6,0 m effective swath)

Nozzle size	Nozzle spacing	Pressure at nozzle (kPa)	Total volume/min	Volume/ha at walking speed of:		
				0,5 m/sec	0,75 m/sec	1,0 m/sec
TK 1 (with 50 mesh sieve)	2 × 3,0 m	150	1,12 ℓ	62	41	31
		200	1,28 ℓ	71	47	36
TK 1,5	2 × 3,0 m	150	1,68ℓ	93	62	47
(with 50 mesh sieve)		200	1,94 ℓ	108	72	54

Acknowledgements

I am grateful to the Department of Agricultural Engineering, Silverton, Pretoria for the use of their patternator, and to Mr. A. Heyns, for programming the computer and for the help and facilities provided. Thanks are also extended to my colleagues for assistance provided.

REFERENCES

1. Rostron, H. (1977). A review of Chemical Ripening of Sugarcane with Ethrel in Southern Africa. *ISSCT Proc* **16** : 1605-1617.
2. Clowes, M. St. J. (1980). Ripening activity of the glyphosate salts Mon 8000 and Roundup. *ISSCT Proc* **17** (in press).
3. Clowes, M. St. J. (1978). Early and late season chemical ripening of sugarcane. *SASTA Proc* **52** : 160-165.

TABLE 5
Pressure at nozzle in relation to gauge pressure at operator's level for various boom heights from ground level

Pressure required at nozzle (kPa)	Gauge pressure (kPa) for boom heights above ground level		
	3,0 m	4,0 m	5,0 m
150	165	175	185
200	215	225	235