

DROP SIZE SPECTRA AND SPRAY DISTRIBUTION

FROM A MICRON BATTLESHIP* DISC

(Revised version)

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Summary Measurements were made of the performance of a Battleship disc rotating at two speeds (2000 and 3000 rev/min) and fed at two rates (500 and 1000 ml/min). The results showed that speed and feed rate both affected the drop size spectrum and spray distribution. Ligament formation was more regular at 2000 rev/min, 500 ml/min than under the other conditions.

INTRODUCTION

Techniques developed for a research project at the NIAE (Byass et al 1976) were used to examine the drop size spectra and spray distribution patterns produced by a Battleship disc (Bals 1978), of the type using two liquid feed tubes. The disc was operated at speeds of 2000 and 3000 rev/min and feed rates of 500 and 1000 ml/min. The electrical supply for 2000 rev/min, 500 ml/min was about 7 V, 0.6A; for 3000 rev/min, 500 ml/min 10 V, 0.8A; for 2000 rev/min, 1000 ml/min 8V, 0.9A; and for 3000 rev/min, 1000 ml/min 11V, 1.2A. The spray solution was water containing 0.1% (v:v) Agral⁺ wetting agent.

DROP SIZE

The drop size spectra were measured from short duration flash photographs using an image analysing computer.

Two mutually perpendicular chords of the unit were photographed for each set of operating conditions; Fig. 1 indicates the areas covered.

*Micron Sprayers Limited
+Plant Protection Limited

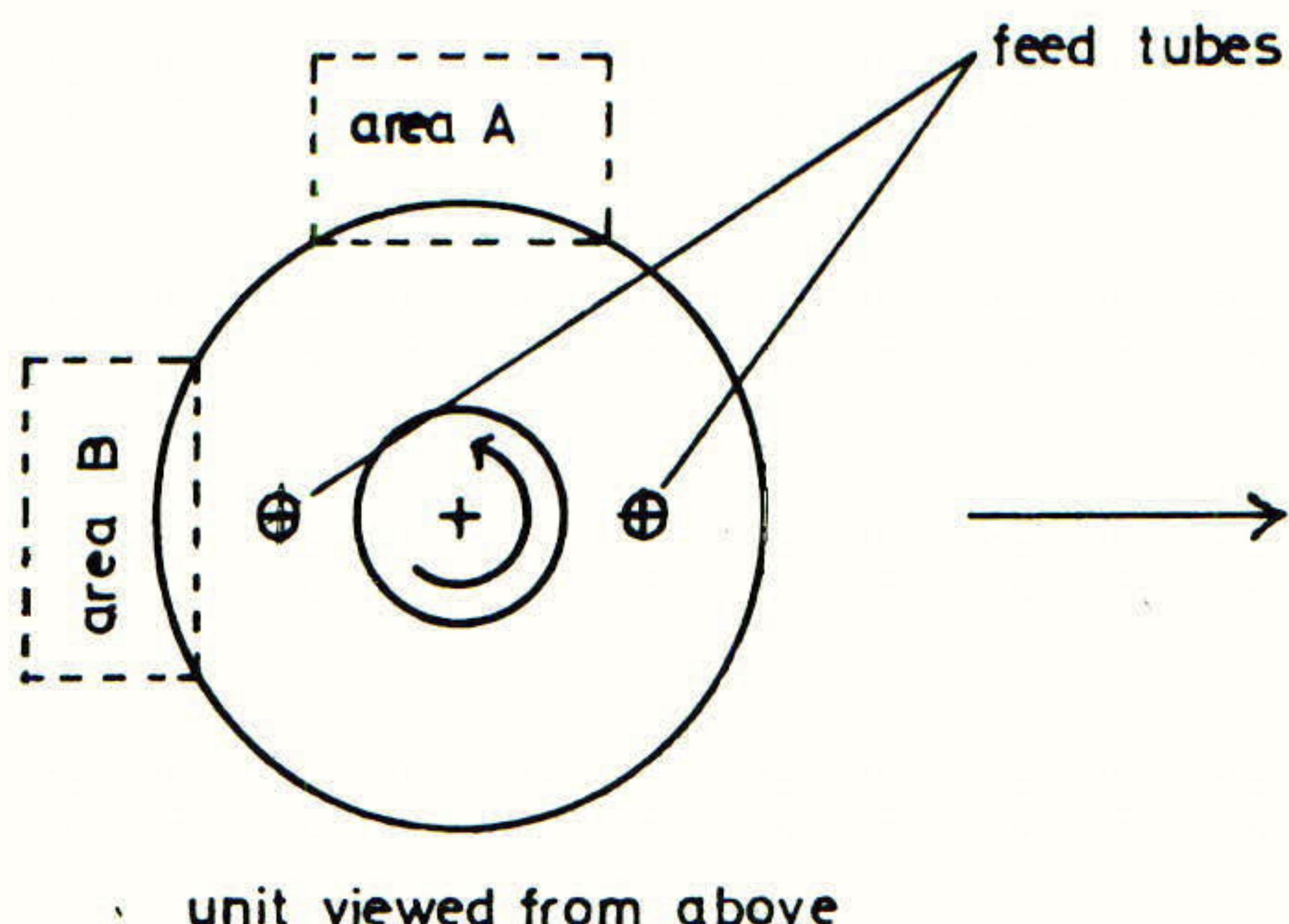


Fig. 1. Areas of unit photographed and direction of travel on conveyor.

The top plate of the unit was cut away to reveal the disc teeth. In each photograph approximately 30 teeth (out of a total of 180) were visible. Examples of enlarged portions of the photographs are shown in Figs. 2 - 9. 16 photographs, of each area were examined to obtain the drop size spectra shown in Fig. 10.

The Battleship disc is designed to produce spray by the break-up of liquid ligaments formed at the teeth around the disc edge. It can be seen in Figs. 2 - 9 that the more regular ligaments were formed at 2000 rev/min, 500 ml/min.

The failure of a disc to produce regular ligaments under certain circumstances is due to the tendency for it to become overloaded as disc speed or liquid feed rate increase (Hinze and Milborn 1950). Figs. 4 and 5 show that localised overloading can also occur. The portion of the disc photographed whilst in position B (Fig. 5) received more liquid than the portion photographed whilst in position A (Fig. 4).

The spectra shown in Fig. 10 illustrate the changes in drop size due to changes in feed rate and rotational speed. The v.m.d. of the spray produced at 2000 rev/min 500 ml/min was 230 μm , compared to 370 μm at 2000 rev/min, 1000 ml/min; 190 μm at 3000 rev/min, 500 ml/min and 250 μm at 3000 rev/min, 1000 ml/min. Thus the v.m.d. increased with increasing flow rate and decreased with increasing rotational speed.

The increase in v.m.d. with flow rate is due to a combination of two effects. Firstly, the ligaments present become thicker and so disintegrate into larger drops, and secondly, if the disc becomes overloaded the ligament formation becomes irregular resulting in a wider spectrum of drop sizes and a larger v.m.d.

The decrease in v.m.d. with increasing rotational speed is due to the increase in energy applied to the atomisation process, and is analagous to the effect of increasing the pressure applied to a conventional hydraulic nozzle.

SPRAY DISTRIBUTION

Spray distribution patterns were obtained, indoors, by attaching the disc to a conveyor and passing it at a speed of 2 m/s over strips of 50 mm wide chromatography paper laid normal to the direction of travel. The direction of travel is shown in

Fig. 1. A fluorescent dye (0.2% w.v. UV39) was added to the spray solution, and this was then extracted from 50 mm lengths of the paper. Fluorimeter readings of the extracts provided a measure of the amount of spray deposited on each 50 mm square of paper. The results are shown in Fig. 11.

The swath width at 2000 rev/min, 500 ml/min was about 1.35 m. The application rate that would be obtained at a forward speed of 2 m/s with discs spaced this distance apart on a boom is about 31 l/ha. For comparison the swath width produced by the Micron Herbi* disc at 2000 rev/min, 60 ml/min is about 1 m (Lake et al 1976). Discs spaced this distance apart would give an application rate of about 5 l/ha at 2 m/s forward speed. The v.m.d. of the spray from the Herbi at 2000 rev/min, 60 ml/min is about 210 μ m, compared to 230 μ m for the Battleship at 2000 rev/min, 500 ml/min, but the drop size spectrum is narrower in the former case.

The pattern obtained at 2000 rev/min, 1000 ml/min shows a heavier deposit on one side of the disc axis than the other. This is due to the localised overloading mentioned previously.

Since all the drops leaving a disc do so with approximately the peripheral speed of the disc, the distance they travel depends upon their size. For example the pattern obtained at 2000 rev/min, 1000 ml/min (Fig. 11) is wider than that for 2000 rev/min, 500 ml/min, due to the relatively larger drops present in the former case. It follows from this that in general, for a spinning disc, uniformity of spray distribution decreases with increasing uniformity of drop size. It should also be noted that patterns of the type shown in Fig. 11 indicate only the relative volume of spray deposited. The spray coverage that is obtained depends also upon drop size. Hence the coverage provided by a given volume of spray deteriorates towards the extremes of the pattern.

CONCLUSIONS

Of the four conditions tested the more uniform ligaments were produced at 2000 rev/min, 500 ml/min. The v.m.d. of the spray produced under these conditions was 230 μ m.

It is likely that the performance of the disc at higher feed rates and speeds could be improved by modifications to the liquid feed system to achieve a more uniform flow to all parts of the disc edge.

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*Micron Sprayers Limited

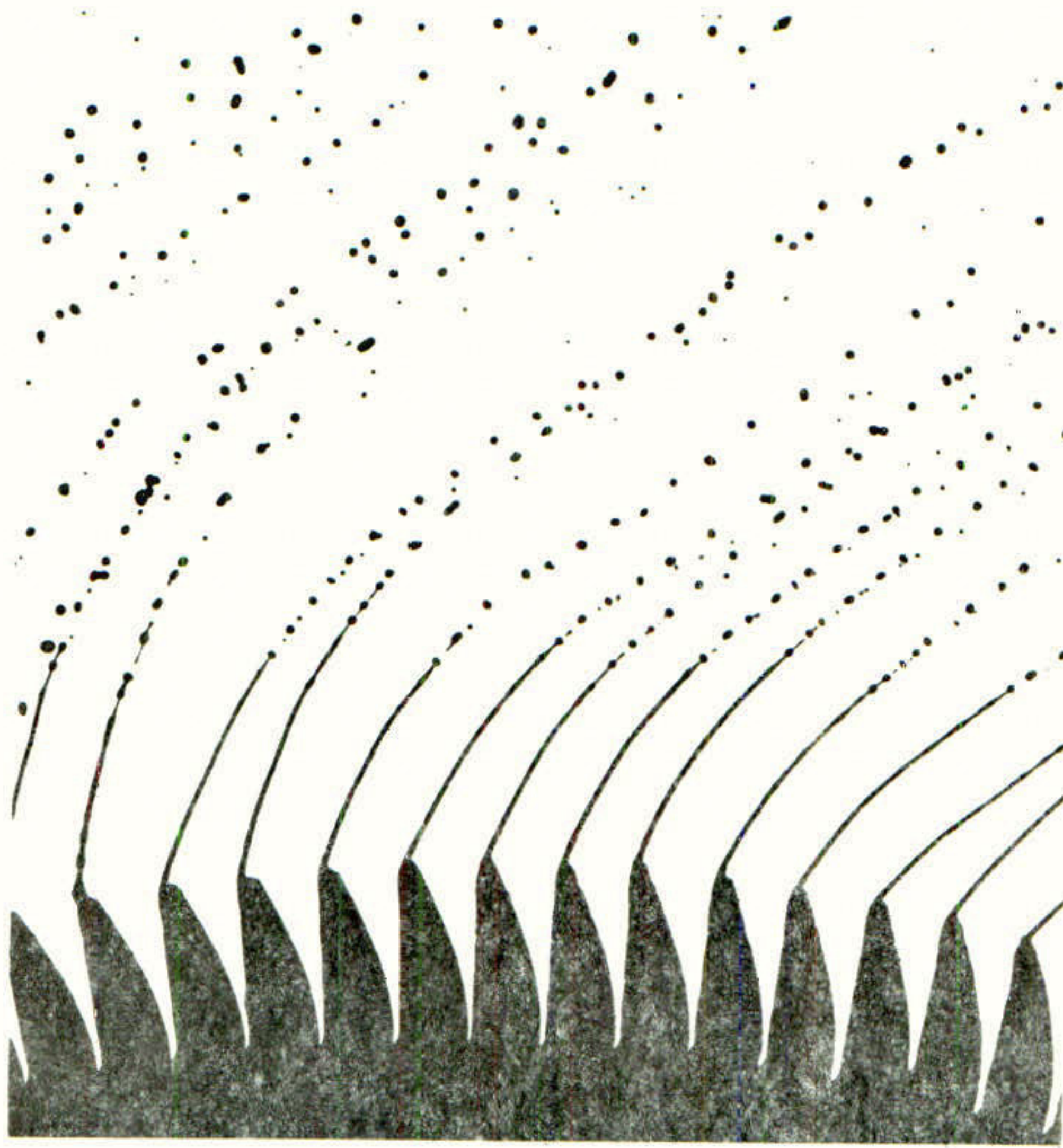


Fig. 2. 2000 rev/min, 500 ml/min,
position A.

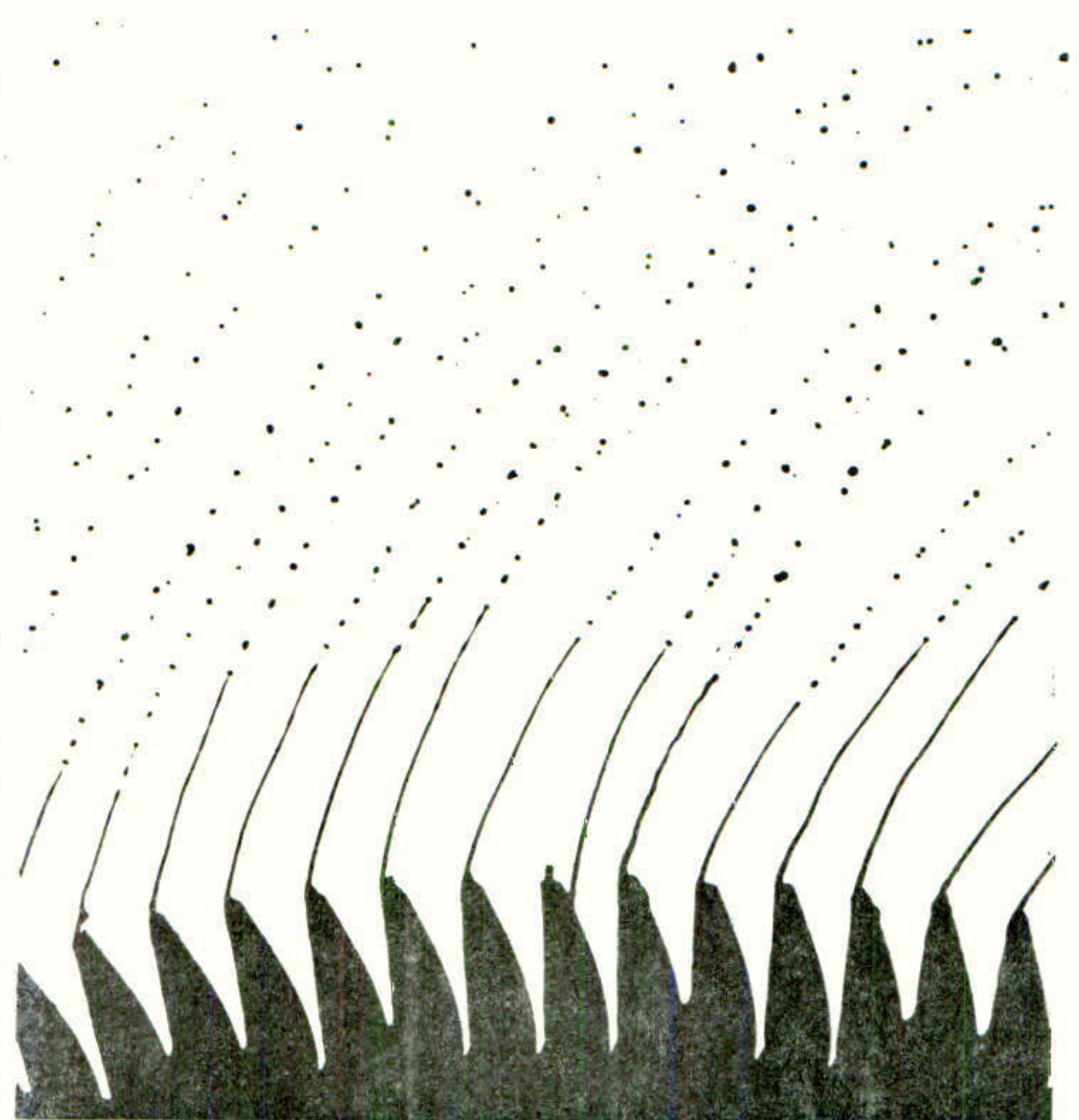


Fig. 3. 2000 rev/min, 500 ml/min,
position B.

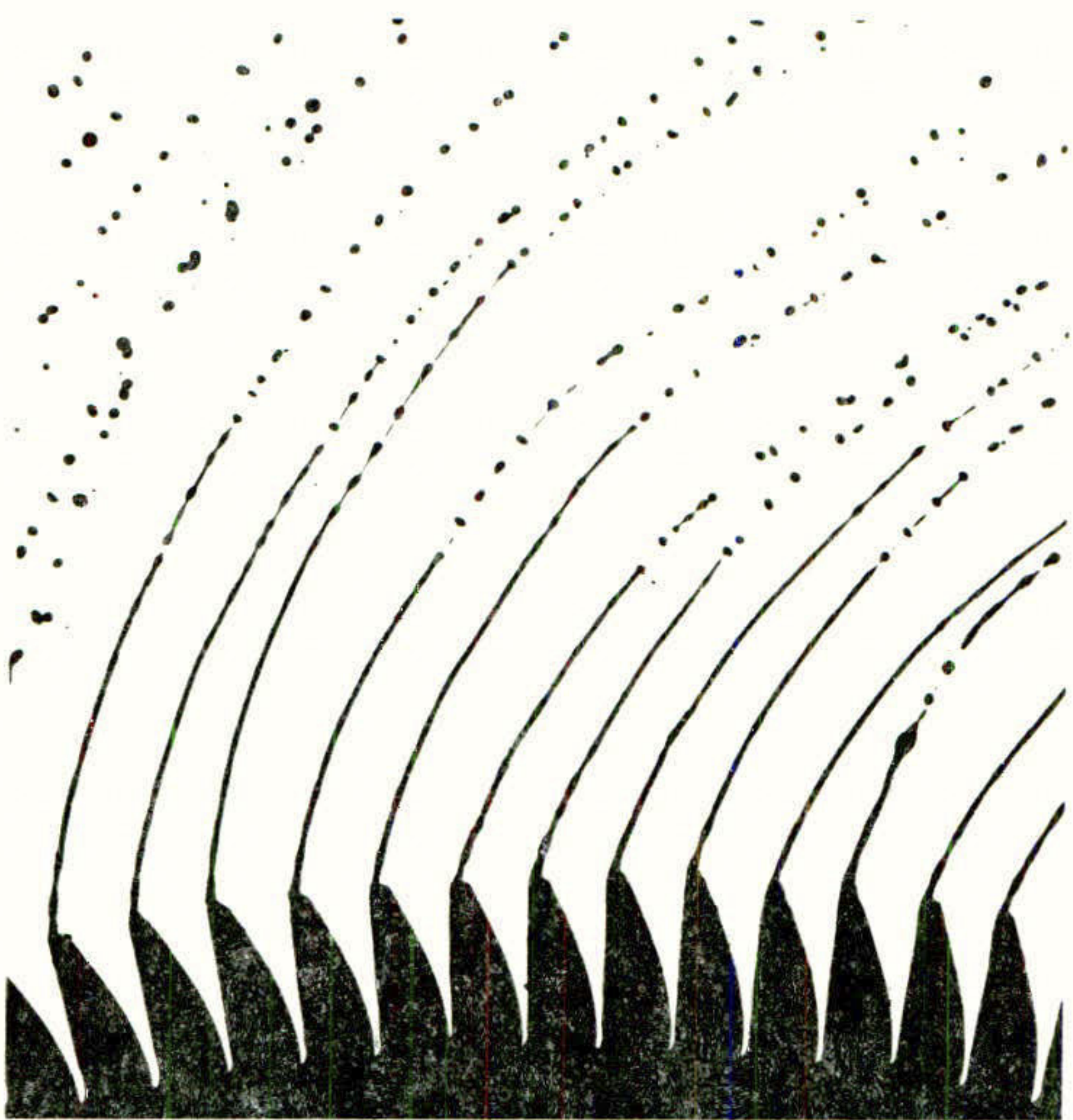


Fig. 4. 2000 rev/min, 1000 ml/min,
position A.

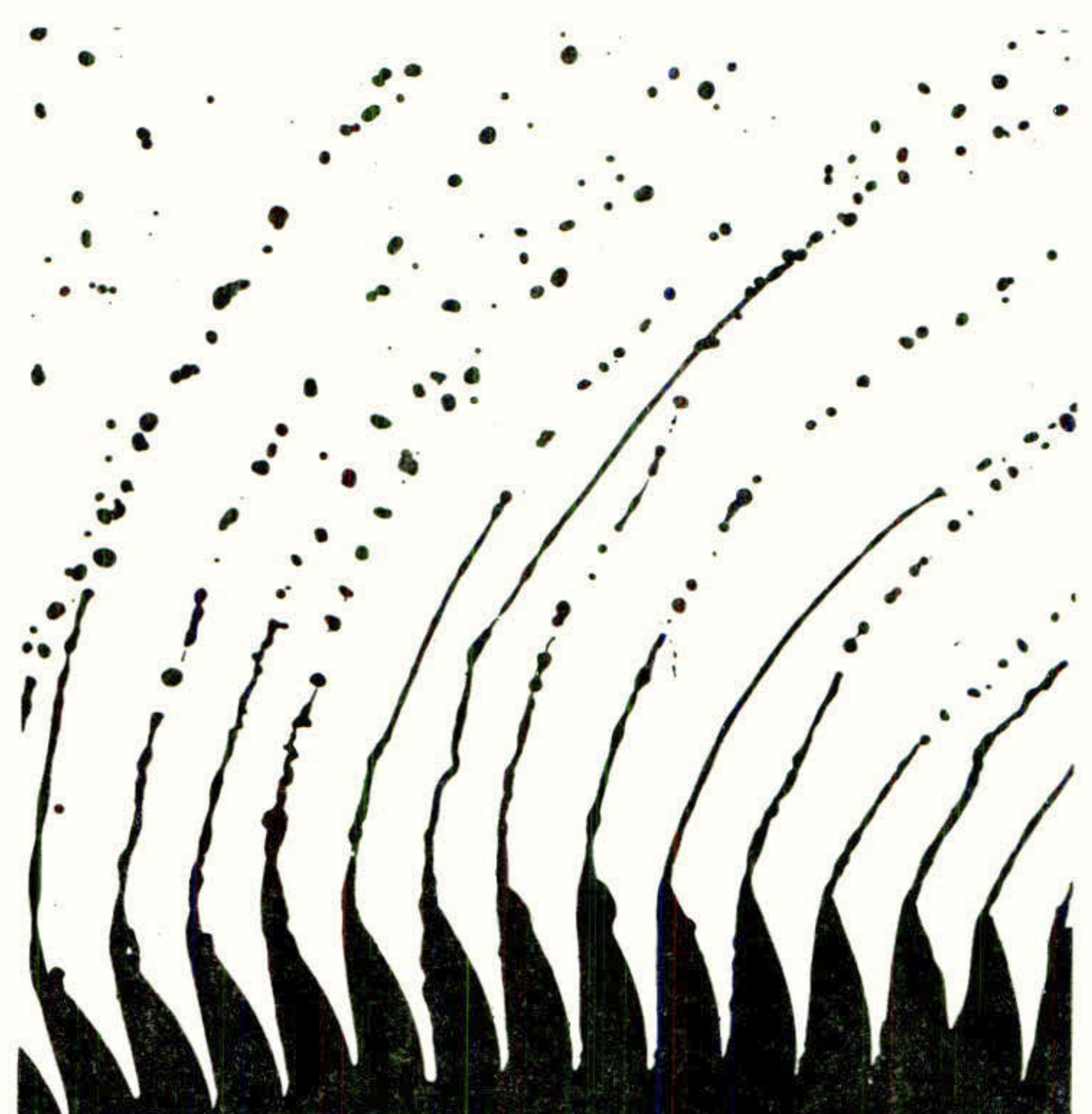


Fig. 5. 2000 rev/min, 1000 ml/min,
position B.

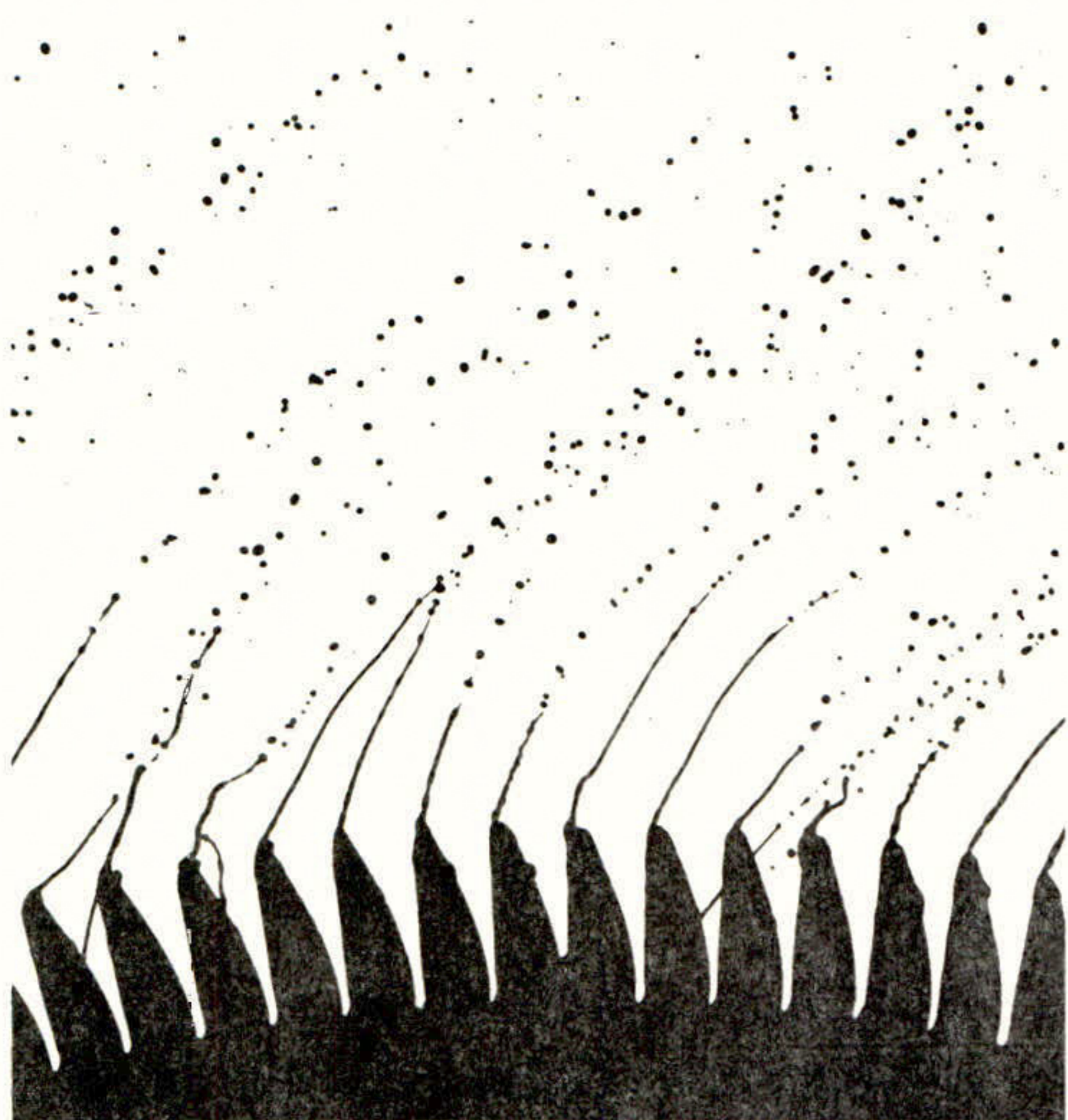


Fig. 6. 3000 rev/min, 500 ml/min,
position A.

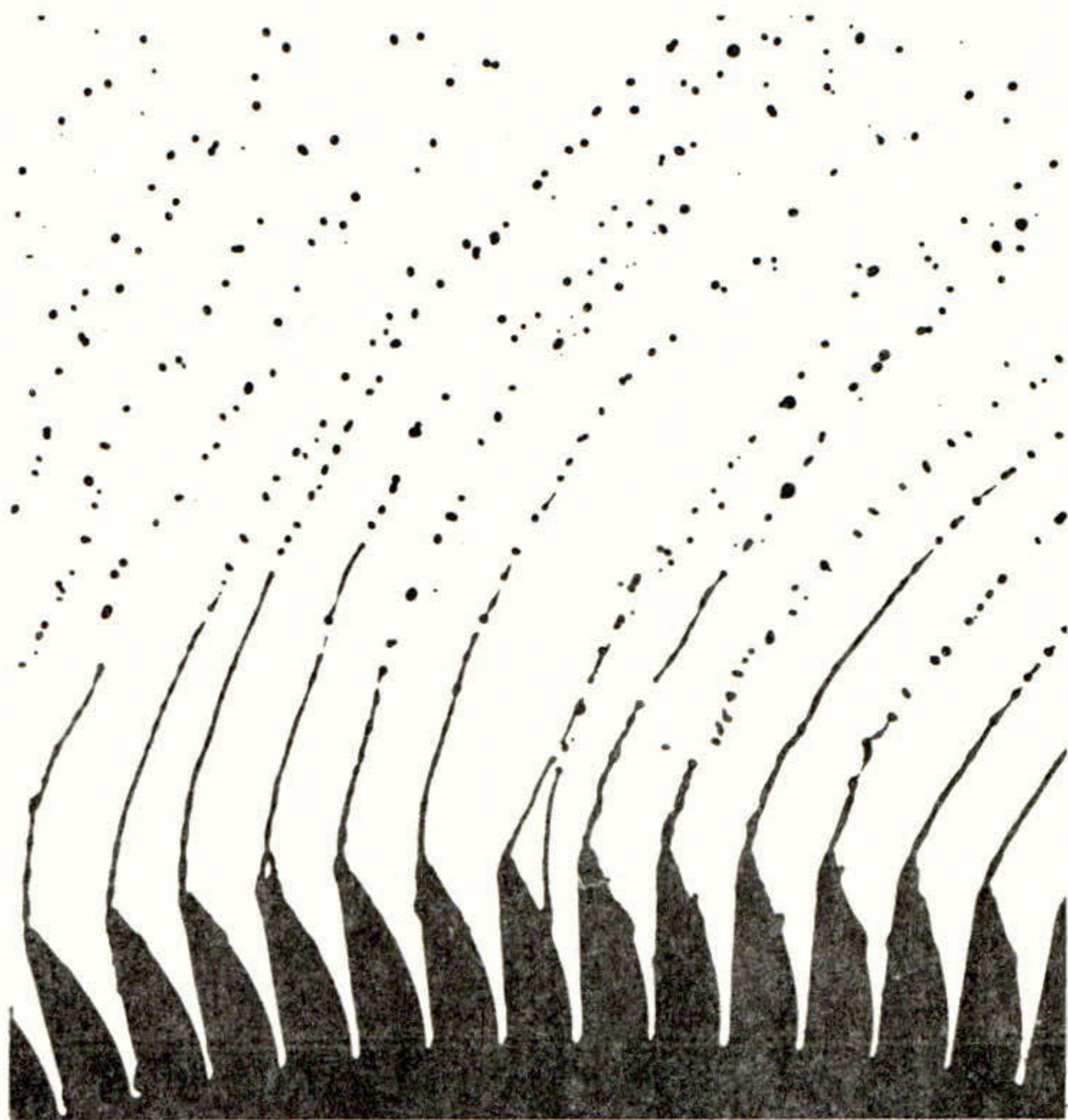


Fig. 7. 3000 rev/min, 500 ml/min,
position B.

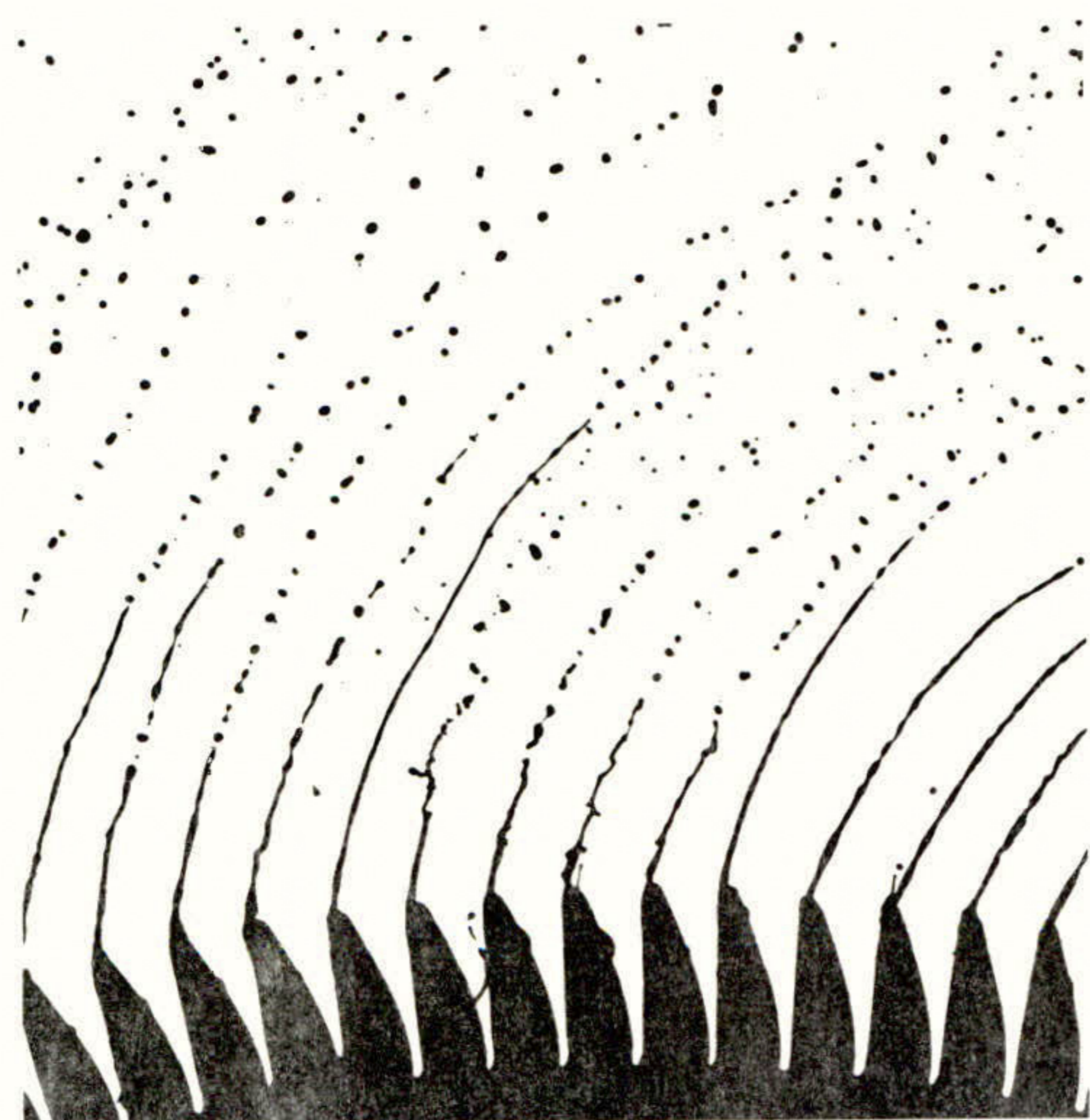


Fig. 8. 3000 rev/min, 1000 ml/min,
position A.



Fig. 9. 3000 rev/min, 1000 ml/min,
position B.

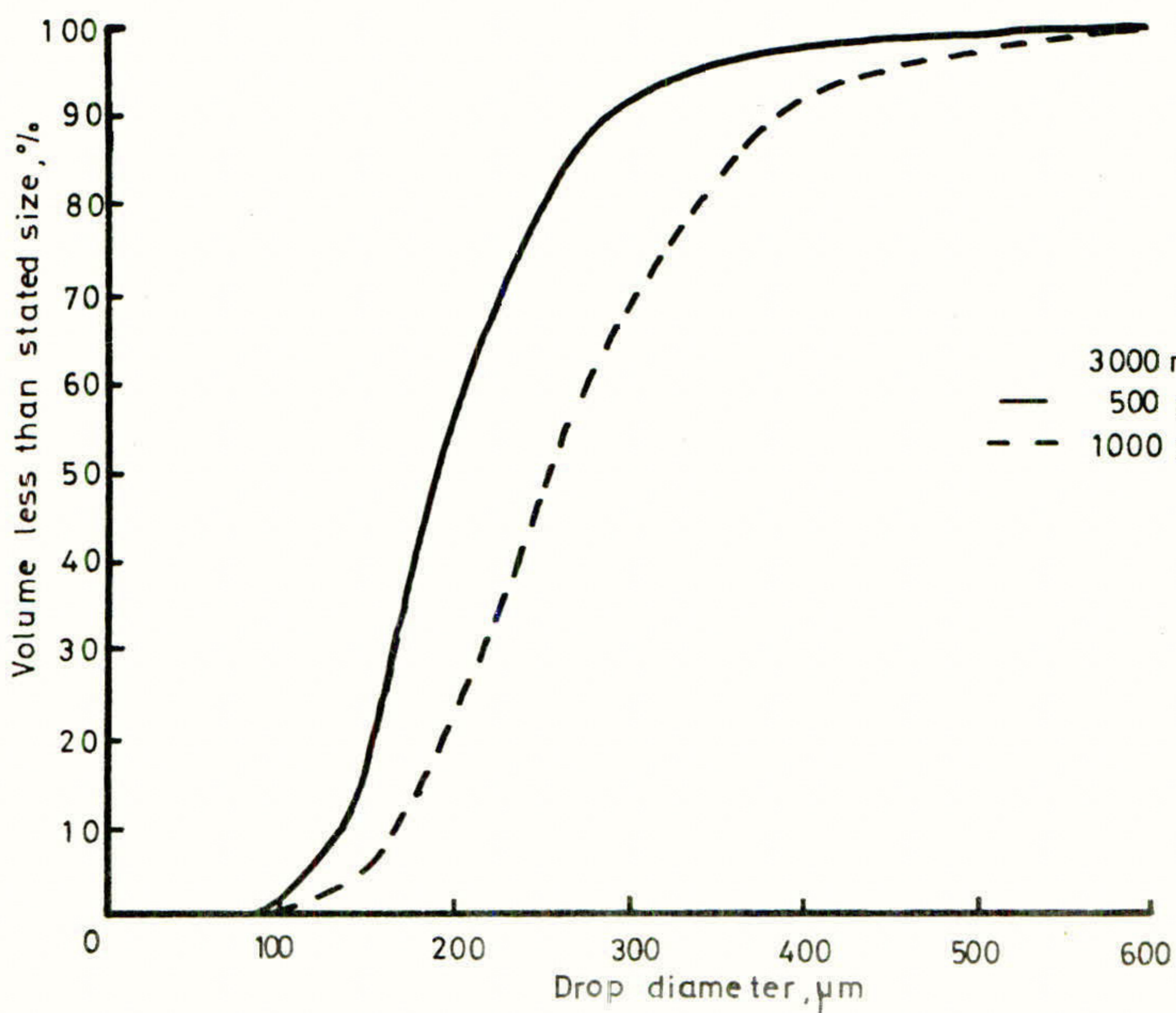
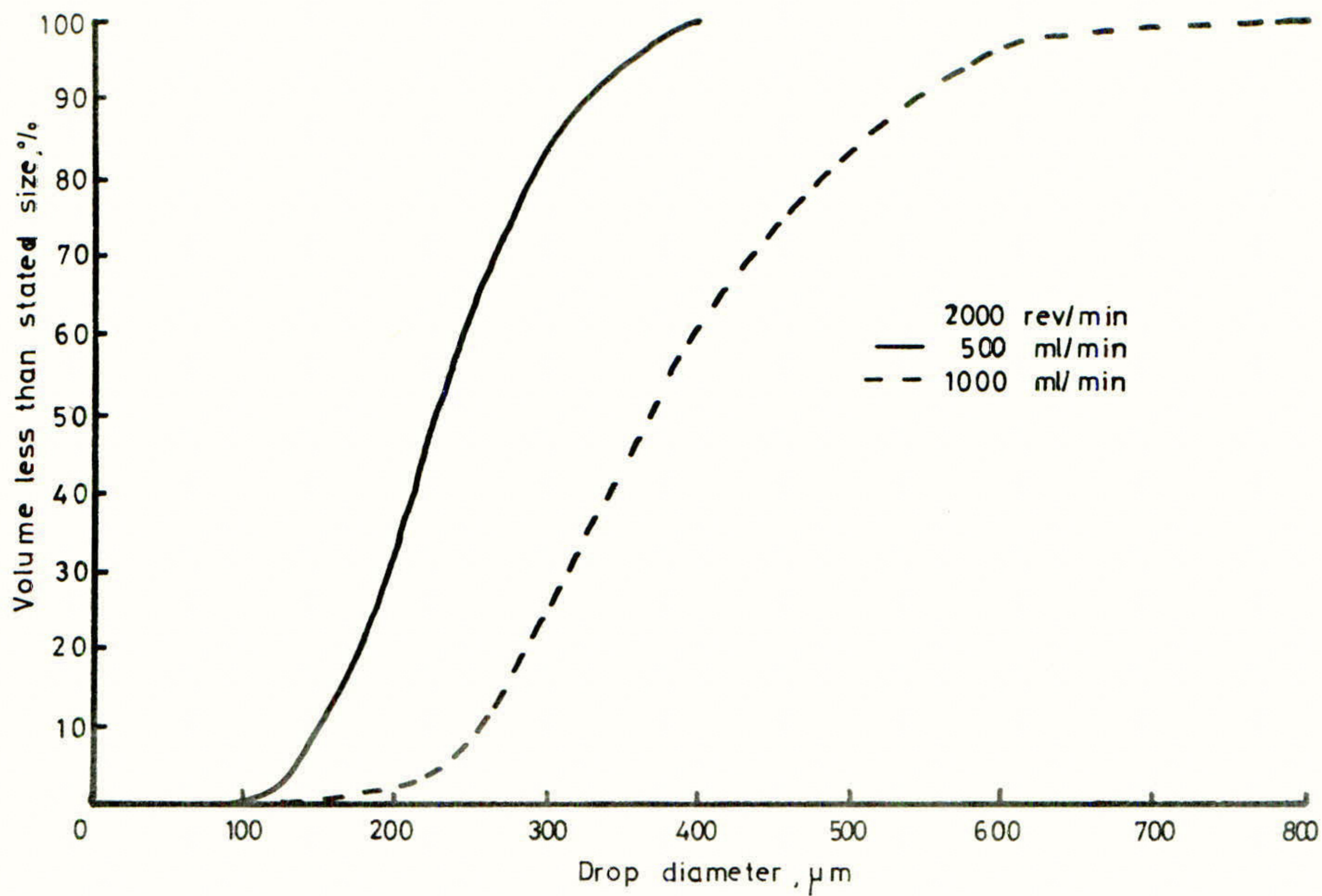


Fig.10 Drop size spectra

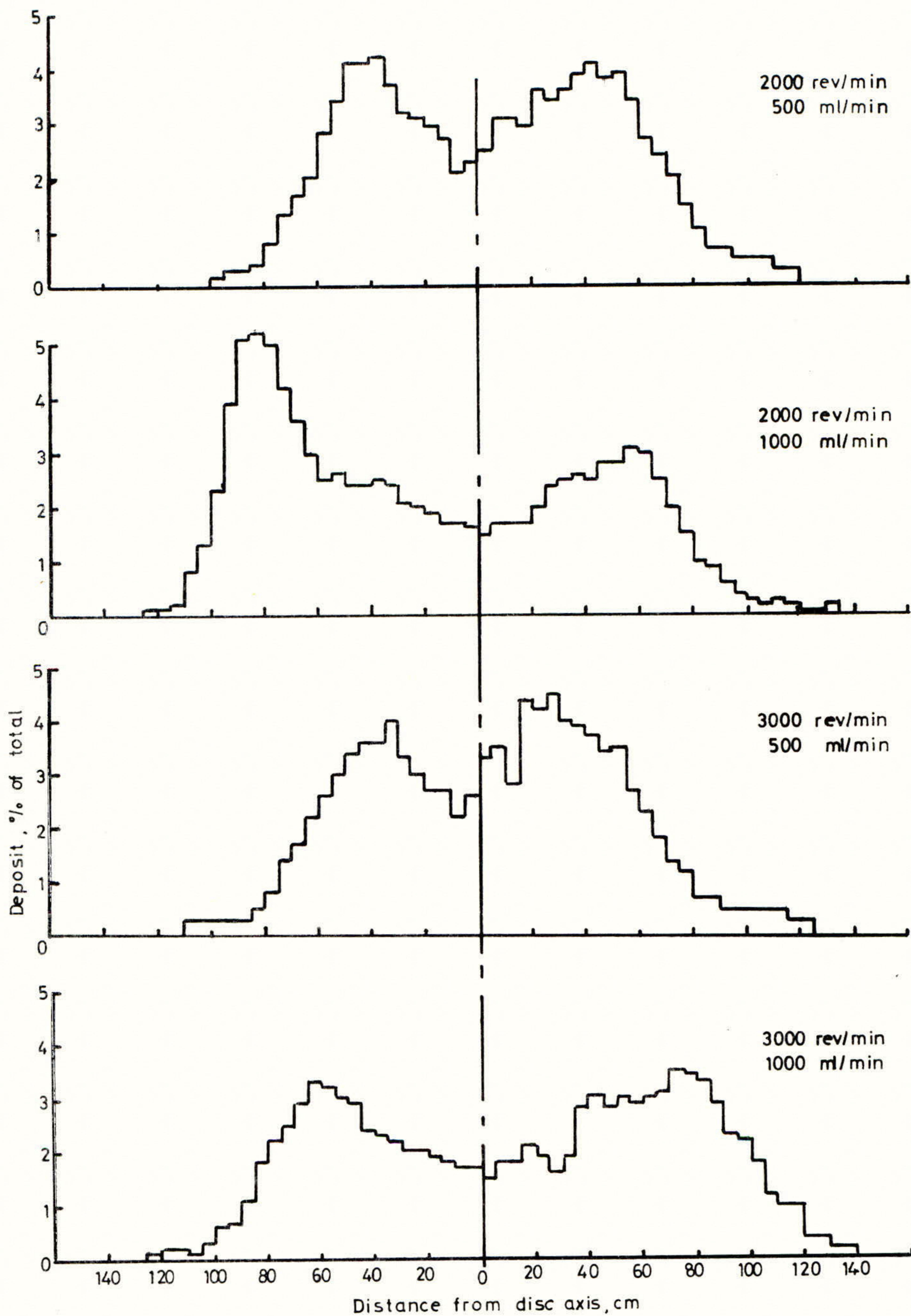


Fig.11 Spray distributions

THE USE OF A METOXURON PREPARATION (SAN 7102)

AS A POTATO HAULM DESICCANT

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Summary Field experiments over the years 1973-78 to study the effect of a metoxuron preparation for desiccation of potato haulm are reported. The compound was slower in its initial activity against leaflets on the haulm than was diquat, but the time taken for complete haulm desiccation was approximately the same. Mixtures of adjuvant oils with SAN 7102 slightly increased its initial activity, but the time taken to reach total desiccation was not reduced compared with SAN 7102 alone. This product, either alone or with adjuvant oils did not cause vascular browning of potato tubers in any trial, whereas both diquat and dinoseb in oil resulted in this type of damage in some trials. Rates of SAN 7102 from 2.0-5.0 kg/ha were evaluated, but the effect on potato haulm was relatively independent of the dosage. Laboratory experiments using soil sprayed with SAN 7102 4-6 weeks previously showed that the compound did not persist in the soil to affect following crops.

Résumé Emploi d'une préparation de Metoxuron (SAN 7102) comme défannant de la pomme de terre. Le rapport présente les essais de plain champ conduits en 1973 sur l'action défannante d'une formulation de Metoxuron sur pomme de terre. L'effet initial sur feuilles a été plus lent avec ce produit qu'avec le diquat mais le temps de dessiccation complète de déiillage fut approximativement le même. L'ajout d'huiles au SAN 7102 a augmenté sensiblement l'effet initial mai le temps de dessiccation complète n' a pas été plus court que dans le cas du SAN 7102 seul. Ce produit, seul ou avec adjuvants huile juse n'a provoqué de luinissement vasculaire des tubercules dans aucun essai, alors que diquat et DNEP plus huile ont donné lieu à de tels accidents dans certains cas. Des doses de 2 a 5 Kg de SAN 7102 par hectare ont été testées mais les effets sur fannes de pomme de terre furent relativement indépendants du dosage. De essais de laboratoire sur sol taité avec SAN 7102 4 à 5 semaines avant rise en culture n'ont sévéle aucure persistance affectant cette. 'Végétation consécutives.

INTRODUCTION

Metoxuron, discovered by Sandoz Limited, Switzerland, has been used for control of Alopecurus myosuroides for several years. (Berg, 1968). It has also been reported that the compound was active against volunteer potatoes in the UK (Lutman, 1976). A preparation based on metoxuron plus special adjuvants was developed for use as a desiccant, and the product was first reported for use in potatoes, hemp and tomatoes by Corpataux and Henauer (1976). The original code number for this product was SAN 7102. Its desiccation action on potatoes and other crops is achieved by foliar and stem absorption of the chemical, which inhibits photosynthesis and causes premature plant death.

With the increase in mechanical harvesting of potatoes in recent years, destruction of the potato haulm has become a necessity. Haulm desiccation makes harvesting easier, accelerates and synchronises tuber maturation, and also prevents the spread of blight from foliage to tubers. However, existing desiccation materials such as dinoseb in oil, diquat and sulphuric acid, can be toxic to the spray operator and the environment. They may also be damaging to spray machinery. With chemicals such as dinoseb in oil or diquat, vascular browning of potato tubers can occur if desiccation is carried out during dry soil conditions.

A material that can be safely applied during these conditions is required. This paper describes the development of such a product (SAN 7102; trade name Deftor) by Hoechst UK Limited in conjunction with Sandoz Limited.

METHOD AND MATERIALS

A total of four replicated trials was carried out during 1973, nine in 1977, and six during 1978. These sites were located in Nottinghamshire, Lincolnshire, Gloucestershire, Worcestershire, Essex and Kent, covering a range of main crop potato varieties and soil types. Chemicals were applied in 300-500 l/ha water using a pressure of 2.5-3 bar. All the trials were sprayed with a Van der Weij "AZO" sprayer using 10m² plots and randomised blocked designs with three replications. All trials included standard treatments and untreated controls.

Different rates of SAN 7102 (containing 80. w/w metoxuron plus special adjuvants) were compared with diquat (83%) or dinoseb in oil (Hoechst DNEP in oil, 9% in 1973 and 1977, and 25% in 1978) in some trials. A tank mix with a potato blight fungicide (fentin acetate or hydroxide plus maneb) was also evaluated. In other trials, the addition of certain mineral oils on the performance of SAN 7102 was investigated.

The product was also tested in ten grower trials, each of area 1 hectare, during 1978. These trials were sprayed with the farmer's own equipment using similar pressures and water volumes as in the replicated trials.

Chemicals were applied at the start of senescence of the potato foliage, which was normally during September. Desiccation of the haulm was recorded at intervals after spraying and the desiccation index (a mean of the % leaf kill and % stem kill) was calculated.

In all years, the yield from each treatment was taken by weighing the marketable tubers from the middle row of each plot. All sites were assessed for tuber quality, i.e., the presence or absence of the "brown ring" effect (internal vascular browning) caused by translocation of chemical into the tuber.

RESULTS

Replicated trials were sprayed to determine the optimum application rate and to investigate the effect of adding mineral oils.

Application Rate

In 1973, rates of SAN 7102 from 2 to 4 kg/ha product were evaluated. The mean desiccation index from four trial sites is shown in Table 1. At the time of application, the crop was just starting to senesce.

SAN 7102 had little effect on the haulm until 7 days after spraying, whereas diquat had an immediate effect. However, by 20 days, all treatments achieved over 90% haulm kill. There appeared to be little difference in effect of the doses of SAN 7102 of 2 and 4 kg/ha.

Table 1

Effect of rate of application on haulm desiccation, 1973 trials

Compound	kg/ha product	Desiccation index (days after application)				
		0	3	7	16	20
SAN 7102	2.0	4	18	48	83	98
SAN 7102	3.0	4	20	46	86	96
SAN 7102	4.0	4	19	45	80	92
diquat	5.4	4	66	85	97	99

In 1977, seven further trials compared rates of SAN 7102 of 2 to 5 kg/ha with diquat or dinoseb in oil. (Table 2). The results were similar to those obtained in 1973, in that SAN 7102 has a less rapid effect on the haulm than either diquat or dinoseb in oil. Again, there appeared to be little relationship between dose of metoxuron and the speed of desiccation, at the rates tested. The addition of a blight fungicide to SAN 7102 had no apparent effect upon the desiccation of potato haulm.

Table 2

Effect of rate of application on haulm desiccation, 1977 trials

Compound	kg/ha product	Desiccation index (days after application)			
		3-5	6-8	14-19	21-28
SAN 7102	2	4	10	72	90
SAN 7102	2.5	3	10	72	95
SAN 7102	3	4	12	78	95
SAN 7102	5	4	15	76	93
diquat	5.4	74	82	98	99
dinoseb in oil	28.0	74	83	95	98
SAN 7102 + (fentin acetate + maneb)	2.5+0.5	3	12	70	90

Similar rates of SAN 7102 were tested in 1978 in six further trials (Table 3).

These results confirmed that SAN 7102 was initially slower in action than diquat or dinoseb in oil, but was equally effective by the final assessment.

There appeared to be a slightly larger response to increased doses of metoxuron in these trials, than in 1973 or 1977 trials. As in 1977, the addition of a blight fungicide to SAN 7102 had little effect upon haulm desiccation, even at double rates.

Table 3

Effect of rate of application on haulm desiccation, 1978 trials

Compound	kg/ha product	Desiccation index (days after application)	
		10-15	25-28
SAN 7102	2	19	82
SAN 7102	2.5	34	90
SAN 7102	5	50	93
diquat	5.4	72	97
dinoseb in oil	10.0	59	76
SAN 7102 + Fentin acetate	2.5+0.5	39	91
SAN 7102 + Fentin acetate	5 + 1	47	98

Effect of Additives

The effect of various mineral oils (Sunthene 410; Sunoil 7E) upon the action of SAN 7102 was investigated. The mean desiccation index from two trials in 1977 is given in Table 4. At application there was approximately 5% crop senescence.

Table 4

Effect of additives on haulm desiccation

Compound	kg/ha product	Desiccation index (days after application)		
		2-5	10-15	21-25
SAN 7102	2.5	4	46	94
SAN 7102 + Sunthene 410	2.5+4	6	57	99
SAN 7102 + Sunoil 7E	2.5+4	6	52	95
diquat	5.4	50	80	99

The addition of mineral oil increased the speed of action of SAN 7102, but the initial effect was still slow compared with diquat. The additives had little effect upon the time taken to reach total desiccation of the crop.

Crop Yield and Tuber Quality

Yield of tubers was taken from three sites, each in 1977 and 1978, covering the main crop varieties Pentland Hawk, King Edward, Majestic, Desirée, and Pentland Crown. Samples of tubers (fifty per treatment) from all sites were assessed for vascular browning. The mean yields and percentage tubers affected are shown in Table 5.

Table 5

Assessment of tubers at harvest

Compound	kg/ha product	Mean relative tuber yield	
		1977	1978
Untreated	-	100	100
SAN 7102	2.5	94	99
diquat	5.4	94	96
DNEP in oil	10.0	91	94

Yields were similar from all the chemical treatments in these trials. In 1977, of a total of nine sites sprayed, only at two sites was any incidence of tuber damage due to vascular browning recorded. Similarly in 1978, such damage was found in only two out of a total of six sites sprayed. No vascular browning occurred in plots which had been desiccated with SAN 7102. Diquat treated plots had a mean of 8 and 11 percent of tubers affected in the years 1977 and 1978 respectively.

Grower Trials

These were sprayed at the first signs of haulm senescence. The mean desiccation index from ten trials in 1978 is given in Table 6.

Table 6

Haulm desiccation in grower trials

Compound	kg/ha product	Desiccation index (days after application)		
		6-7 days	16-18 days	24-28 days
SAN 7102	2.5	9	43	95
dinoseb in oil	10.0	52	72	88

As in the small-plot trials, SAN 7102 was initially slower acting than dinoseb in oil, as shown by assessment after 6-7 days. By 24-28 days after spraying, however, SAN 7102 had given a superior haulm kill compared with dinoseb in oil.

Soil Persistence Tests

Soil taken from SAN 7102-treated plots 4-5 weeks post spraying was used in laboratory tests to evaluate persistence by measuring the germination of oilseed rape.

Mean percentage germination in untreated soil (two sites) was 93% and in treated soil 97%.

DISCUSSION

These results have confirmed that SAN 7102 gives a more gradual desiccation of potato haulm, compared with diquat. However, by about 3 weeks after treatment, there was little difference between the two products. The results also confirm the earlier work of Corpataux and Henauer (1976) who found no effect on quality of potato tubers treated with SAN 7102.

As the haulm dies off more slowly after metoxuron treatment, there is a danger that potato blight could infect the haulm, and possibly also the tubers. These trials have shown that a tank mix with a fungicide such as fentin acetate or hydroxide is possible. The desiccant could be routinely incorporated with a final blight spray.

SAN 7102 has given good results in these trials using from 300-500 litres of water per hectare. Experiments in Holland in 1974 showed that 300 litres of water was the minimum volume needed for effective haulm desiccation when the product was applied by ground machinery. (Corpataux and Henauer, 1976). However, good results were achieved by aerial application in only 30 litres of water per hectare. The low toxicity and non-corrosive nature of the product makes it suitable for aerial application. SAN 7102 is also active against several important weeds found in potatoes, including Chenopodium album, Polygonum lapathifolium and Stellaria media.

Laboratory experiments have shown that oilseed rape germinates satisfactorily in soil sprayed 4-6 weeks previously with SAN 7102. It appears therefore, that there are no chemical residue problems for following crops.

Acknowledgements

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1972-1978

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2. FOREWORD

The National Wild-Oat Advisory Programme drew together many organisations within the United Kingdom agricultural industry in a unique joint extension venture to combat the spread of one of the worst weeds of our cereal crops. The programme was a major step forward in the developing scene of weed control in the UK and for that reason alone deserves to be documented.

All who participated in the programme are indebted to the British Crop Protection Council for publishing this report. It is a record of how a particular advisory programme was organised, of the degree of success achieved and of the difficulties encountered, so that others may be inspired to develop and improve on this combined approach to advisory work where it seems appropriate. Extension specialists in this country and elsewhere will I hope study this report with interest.

I would wish to add my personal thanks to all the representatives of the organisations listed in the review who so wholeheartedly gave their time and energy in support of the programme.

Albert J. Davies

CHAIRMAN, NWOAP STEERING COMMITTEE

3. INTRODUCTION

During the 1960s wild-oat increased rapidly following the intensification of cereal growing. Advisory activity against the weed was sporadic and local. By the early '70s it had become apparent that wild-oat had extended its spread into all parts of the UK and that it posed a serious threat to arable farming particularly intensive cereal growing. (Phillipson 1974).

Discussions within the ADAS Agriculture Service led to the proposal for a national programme which would co-ordinate the advisory and promotional input from both within and outside the service.

Thus, in July 1972, representatives of Agricultural Development and Advisory Service, Agricultural Research Council, British Agro-Chemicals Association, British Association of Seed and Agricultural Merchants (now UKASTA), British Crop Protection Council, Department of Agriculture and Fisheries for Scotland, Home-Grown Cereals Authority, National Association of Agricultural Contractors, National Farmers' Union, and Scottish Colleges, met and agreed that the idea was sound and likely to produce tangible results. A small executive group was given the task of planning details by which the aims agreed at the meeting would be met.

The timing of subsequent events is given at Appendix I. An account of the first 2 years of the programme and their evaluation has been published previously. (Hughes and Thomson 1975)

4. AIMS AND OBJECTIVES

The agreed aims were:-

- a. To demonstrate to farmers the costs of harbouring wild-oat, to educate them in the means by which the seeds are spread and the methods by which the risk of introducing them can be kept to a minimum;
- b. Teaching the correct identification of wild-oat as seeds, seedlings and mature plants;
- c. Making available relevant information about control methods at all levels of infestation;

with the objective of reducing the weed to negligible levels in infected areas and decreasing the chance of its ingress and build up in remaining clean areas.

The emphasis was to be placed on large numbers of small local events and a regionally based organisation was introduced.

5. ORGANISATION AND STRUCTURE

5.1 Nationally

A Steering Group with representatives from all the above organisations and later also from the Agricultural Training Board, Ministry of Agriculture, Fisheries and Food Seeds Branch and Ministry of Agriculture for Northern Ireland met twice yearly to review the situation and to guide and endorse the activities of the Executive Group.

The Executive Group consisting of 10 people from ADAS, ARC, ATB, BAA, BASAM, NAAC, NFU and Scotland, met 4 times a year.

These 2 groups shared a common secretary (a Technical Officer from ADAS) and were chaired by Senior ADAS Agriculture Arm Advisers.

Working Parties usually of 3 or 4 people met as required to prepare drafts of programme literature and to discuss specific problems.

5.2 Regionally and Locally

Regional Co-ordinating Committees were arranged in 12 Regions - 8 in England and Wales, 3 in Scotland plus Northern Ireland. In all cases these were chaired by a member of the Advisory Services and membership included representatives from all the organisations previously mentioned except ARC and BCPC with the addition in some regions of a representative from the Central Association of Agricultural Valuers and ADAS Lands Service.

In some regions (Wales, South-East) divisional or area co-ordinating groups with members from outside ADAS operated in addition to a regional group.

5.3 From the outset of the programme it was emphasised that each regional group was responsible for organising and executing its own promotional and advisory activities.

The national groups provided overall guidance on major issues, organised the production of suitable promotional literature and other advisory aids as well as acting as a clearing house for ideas and problems. The Executive Group in particular acted in this way receiving and reviewing minutes of the regional group meetings and sending them information.

5.4 Finance

In order to pay for assistance from a specialist firm in the design and production of programme literature a National Wild-Oat Advisory Programme Fund was arranged to which many of the organisations involved contributed. The fund was administered by the Secretary of BASAM (now UKASTA). Initial contributions totalled £1,000. This sum was increased by revenue from the sale of bulk amounts of the programme literature, the production of which used up nearly all the money. The later production of a revised edition of the booklet was financed in a similar way partly by contribution and partly by bulk sales.

6. MONITORING PROGRESS

It was agreed at an early meeting of the steering group that progress should be monitored as the programme proceeded and the following items were arranged.

- a. National register of events. This was to show the number and type of activities, advisory events and attendances. Details were collected at six-monthly intervals from Regional Co-ordinators and tabulated by the Secretary to the Programme Committees.
- b. A postal penetration study.
- c. A qualitative in depth interview study.

The last 2 were organised by the ADAS Extension Development Unit at Reading and each was carried out in 4 different regions of England and Wales.

- d. A post-programme survey of wild-oats on Farms. In the event this took place before the formal end of the programme since the information was deemed to be necessary and useful to interests beyond those of the NWOAP.

7. ACTIVITIES UNDERTAKEN

7.1 Regional Activities

A consolidated summary of activities recorded in the register of events is given at Appendix II. This is likely to be an under-estimate since not all regions completed full returns each time. An arbitrary figure of 40 people attending divides large meetings from small ones. It is notable that the number of events at which wild-oat formed a major item were maintained through the life of the programme.

The number of articles was also maintained no doubt partly due to the fact that the monitoring studies carried out suggested that most farmers liked getting their information in this way and could recall earlier items when interviewed. (Thomson 1975)

An interesting development during the programme was the installation of Telephone Information System in several Divisional MAFF and Scottish Advisory Offices. Topical wild-oat control information was relayed by this method.

It was appreciated at the outset that differences in the intensity and distribution of the weed in different areas would require different advisory approaches. The national summary of events conceals the very different styles of activities in different regions. For instance, in Eastern Region the emphasis at the start was almost entirely on the correct use of herbicides. The intensive sequential mailing of postcards and letters with topical information together with large conferences and field demonstrations formed the major part of the programme. In West Midlands many smaller events were held, many short articles published and static exhibits arranged at markets and other farming centres. Within some regions different approaches were needed in different areas; for example in Cumbria the emphasis had to be placed on creating awareness and teaching recognition whereas in Northumberland an intensive mailing programme covering all control aspects but particularly timely herbicide use was carried out.

In Scotland the programme was organised through the Colleges. In the West the main activity was the annual production of a simple awareness leaflet for extensive mailing. In the East very diverse activities were undertaken extending from locally produced sheets of technical information to supplement the nationally produced "Guides" to the promotion of training courses on wild-oat recognition and roguing. Contractors in this area, used to provide a potato roguing service, extended this to include wild-oat roguing in cereals. In the North an annual survey of wild-oat was carried out and the results used at farmers' discussion groups and exhibits.

In Northern Ireland also an annual survey was carried out to monitor the progress of the initial infestations which were seen just before the commencement of the national programme. An educational exhibit was taken round to many centres during an intensive advisory programme and exhibits were also mounted at farming shows.

7.2 National Committee Activities

7.2.1 Programme Literature and Other Promotional Material

Initially the aim was to produce durable material that would be complementary to existing advisory leaflets together with posters and mail stickers of a more ephemeral nature. The following were produced:-

- a. Booklet: Wild-Oat Guide to Action - 13 000 + 6 000 in 1972
Wild-Oat Guide to Action, Revised Reprint - 15 000 in 1975
- b. Folded Card: Know your Wild Oat - 24 000 + 2 000 in 1973
- c. Poster: 6 000 Revision: 6 000
- d. Mail Sticker 10 000 distributed through BASAM and NAAC.

All these items were funded as in paragraph 5.4 above.

Other supplementary guides were produced by MAFF on behalf of the Group:-

Guide to Wild-Oat Roguing (Spring 1975, Revised 1976)
 Guide to Cleaning Combine Harvesters (May 1975)
 Guide to Efficient Use of Mobile Cereal Seed Cleaners (January 1976)
 Guide to Wild-Oat Herbicides (May 1976, Revised May 1977)
 Guide to Application of Wild-Oat Herbicides in Cereals (October 1976)
 Guide to Cultural Control of Wild-Oat (October 1976)
 Wild-Oat Guide to Prevention of Spread (August 1977)

Some of these were produced by Working Parties, others were individual efforts, but all drafts were finalised in agreement with all organisations concerned. This took a considerable amount of time in the case of the leaflet on the use of mobile seed cleaners and also the one dealing with cleaning combine harvesters because of very widely divergent initial views of various bodies which had to be reconciled before publication.

7.2.2 Advisory Methods Guide

At the commencement of the programme Regional Co-ordinators were sent a list of suggested activities and guidelines on organising promotional events under the headings, Group Activity, Winter Meetings, Conferences, Field or Farm Demonstrations. This was supplemented by a list of speakers who could be approached for specific wild-oat topics at larger conferences.

7.2.3 Prior to publication the draft of many of the leaflets were sent to contacts within the national farming press. This material was given prominence in a series of linked articles in "The Farmers' Weekly" and also appeared in other periodicals.

Locally produced articles suitable for wider use were circulated to Regional Co-ordinators via the Secretary of the Executive Group with the intention of encouraging articles on wild-oat topics in Divisional Bulletins.

Periodic articles were produced for the MAFF Current Topics series.

In the early stages a comprehensive technical note on wild-oat was written at the Weed Research Organisation and was circulated to all cereal growers as an HGCA Technical Newsletter.

7.2.4 Slide Collection

Initially the Executive Committee decided that regions should produce their own slides with local material for use at meetings but after several requests from more than one Region a collection of "key phrase" slides was produced and copied to all regions for use with local pictorial slides.

7.2.5 Technical Information

At the commencement of the programme a literature reference list and comprehensive collection of reprints was sent to each Regional Co-ordinator. These were a selection of the very large amount of literature published and were grouped under the following sections.

General fate of wild-oat seed, wild-oat in the presence of cereals, wild-oat in cereal seed, herbicides for wild-oat control.

In addition a collection of the latest commercial literature from each of the firms with wild-oat herbicides was sent to Regional Co-ordinators soon after the start of the programme.

These activities were not repeated since the technical references were superseded by the publication of the book "Wild-Oats in World Agriculture" and nationally produced leaflets summarised the commercial literature.

7.3 Press Conferences

These were organised by MAFF Press Branch and held at Whitehall Place, London, as follows:-

- | | |
|------------------|--|
| 12 February 1973 | Programme launched by ADAS Director-General, Sir Emrys Jones. |
| 10 March 1975 | A review of the progress to date stressing its continuation given by the Chief Agricultural Officer, A J Davies. |
| 13 February 1978 | To announce the formal ending of the National Organisation set up to run the programme. |

Each of these Press Conferences was well attended and resulted in much publicity in the National Daily Press as well as agricultural and local papers.

Throughout the programme the Agricultural Press played a particularly important role in the communication link with farmers.

7.4 Agricultural Training Board Activities

The ATB participated actively in the programme by having a member in the Executive Group and also by supporting regional and other local groups.

Under the stimulus of the programme wild-oat control was given prominence in the following courses:-

- Estimation and Roguing of Wild-oat.
- Supervision of Spray Chemical Applications.
- Field Crop Sprayer Operation and Maintenance.
- Combine Harvester Operation and Maintenance.

7.5 Project "Panic"le"

In Spring 1976 a PR agency retained by a group of 6 chemical manufacturers (the Industrial Wild-Oat Group) presented a plan of activities to be financed by the consortium with the object of furthering the aims of the national programme. This was welcomed by the Steering Group and subsequently became known as Project "Panic"le" the name given to a newspaper produced in large numbers (67 000) 2 or 3 times a year.

The agency under the direction of IWOG also produced a colour wall chart and car window stickers as well as organising a student project competition with a study tour prize.

A poster designed by the Group was financed from the residue of the NWQAP fund.

Tapes with topical information on wild-oat matters were recorded and despatched regularly to Agricultural Broadcasting Programme Producers. These were used regularly by several local Radio Stations and occasionally in programmes put out nationally.

8. DIFFICULTIES EXPERIENCED

8.1 National List of Activities

It had been hoped to organise a calendar of future activities throughout the UK to avoid undue clashes and to make useful publicity material. The Secretary found it impossible to collect sufficiently firm details of planned events from all the organisation involved in time for it to be of practical use. ADAS events were, however, promulgated in the national Forthcoming Events list as well as locally.

8.2 Involvement of Young People and Educationists

In spite of more than one approach to the National Federation of Young Farmers' Clubs it was not found possible to stimulate the interest of this body sufficiently to help in the national programme. Similarly, it proved difficult to involve students on agricultural courses. More might have been achieved if a firm liaison with the Association of Agricultural College Principals had been established at the outset. The Industrial Wild-Oat Group "Panicle" project in beaming part of its efforts specifically at students also had a disappointing response to a student competition in spite of the very attractive travel prize offered.

8.3 Monitoring Individual Advisory Activities

It had been hoped to introduce wild-oat advice into the ADAS diary entry coding system as a recordable item but this was not achieved. ADAS does not have the sole prerogative for giving advice on farms, and information from trade and other advisors would have been necessary to complete the picture.

8.4 Use of Radio and TV

Although many tapes were made for and used by local Radio and several items were arranged for national farming programmes a disappointing reaction was obtained from contact with TV Agricultural Producers. It had been hoped to use this last medium much more widely and many people were willing to co-operate in the production of specific wild-oat programmes. However, some awareness of the problem was achieved through this medium because of the heavy advertising campaigns held by several chemical manufacturers.

8.5 Adverse Actions of Outside Agencies

8.5.1 Pipe laying schemes and major roadway building or re-alignment were found to harbour wild-oat plants on soil heaps and land for which responsibility was changing and difficult to assign. Discussions with Department of the Environment Officers did not fully resolve the situation and it was concluded that quick action at a local level was needed to counteract such nuisances.

8.5.2 Contamination of feed grain with wild-oat. Discussions with those concerned brought about an improvement in the way the grain was handled so the risk of the seeds infesting fields adjoining transport routes was decreased. It was not found feasible to take any positive action to prevent the sale of heavily contaminated pet food sold for rodents and pigeons.

8.5.3 Sale of wild-oat panicles for floral decoration

Although publicity persuaded at least one large store to cease trading in imported wild-oat panicles these were frequently seen in florists' displays during the programme.

An investigation of a limited sample of these panicles revealed that they were not *Avena fatua* and therefore unlikely to constitute a serious hazard. However, it was not possible to check all sources and the risk of importing wild-oat in this way was constantly being brought to the attention of the executive group.

9. DISCUSSION

The survey results of 1977 (MAFF 1977) cannot be directly related to those of 1972 (Phillipson 1974) but general points can be made even if the direct results of the programme cannot be measured from them. At the end of the five-year programme the survey showed that wild-oat had continued to spread on farms throughout the UK. There was a clear indication of a large increase in the use of wild-oat herbicides and signs that the weed was being satisfactorily contained in most areas previously seriously infested. It was also clear that there was far more awareness of the weed amongst farmers.

In the second and third years of the programme rapidly rising cereal prices and consequential profitability of cereal farms assisted in the uptake of wild-oat herbicides as well as other pesticides. Commercial organisations promoting their products with intensive advertising campaigns helped maintain an interest in and awareness of the wild-oat problem. The development of several new wild-oat herbicides as well as reformulation of existing ones also helped in this respect.

A survey of sprayer operation efficiency in 1976 indicated that although there was some improvement over the results of previous surveys there was still room for improvement in the way herbicides are applied. (MAFF 1976)

The use of herbicides was just one part of the systematic control of wild-oats which was stressed with increasing emphasis by the Executive Group and various Working Parties. While the initial emphasis of the programme was largely centred on awareness of the problem the control of wild-oat by all available methods and the prevention of its spread was a major part of the initial literature and became the main message the national committees wished to promulgate as the programme progressed.

One problem discussed repeatedly at the committee meetings was that of maintaining the impetus of the programme. It was sometimes felt that a changing membership of the Executive Group might have brought forth more new ideas. As the programme continued in an era of Government Service "Cash Limits" and an ADAS desire for maximum cost effectiveness, which severely limited the amount of finance available, the group of chemical manufacturers supporting the programme and organising a sizeable fund to enable a new style of promotional activities to be carried out did much to maintain the impetus of the programme during its last 2 years. Financial support was also forthcoming from the British Crop Protection

Council which enabled a new publicity poster to be produced and contributed to the cost of the programme's documentation.

It is not possible to do more than guess what the current wild-oat position would be if the national wild-oat programme had not taken place. There has been a dramatic increase in sales of wild-oat herbicides over the past 5 years and there is no doubt that Advisers (commercial, independent and "official") and farmers gained much confidence from the information agreed by all parties that has been put out under the name of the programme.

However, a "grey area" situation continues where the population of wild-oat hardly merits chemical treatment on the basis of short-term economic gain in crop yield yet exceeds the number that can be practicably rogued.

The means of dealing with this situation demands future attention by research workers and advisers if the eradication of wild-oat is to become a reality.

10. COMMENTS FROM PARTICIPATING ORGANISATIONS

10.1 Agricultural Research Council

A striking outcome of the programme has been the speed with which research findings have been interpreted and conveyed to the farming community by means of literature, meetings etc. The reciprocal feedback of farmer reaction to new suggestions has also been much more rapid and authoritative than normally occurs. At the outset there was a tendency to base advice on a superficial understanding of wild-oat. It quickly became apparent that simple and reliable guidance to farmers could come only from the research on the population dynamics of wild-oat seed as affected by cultural factors common in cereal husbandry.

10.2 Agricultural Training Board

As a direct result of the programme, the ATB examined its own role and concluded that its aims should be to make a contribution towards:-

- a. Development of the skills of wild-oat control.
- b. Development of the routines and habits which would prevent its spread.
- c. Development of the right attitude towards wild-oat control (without which the skills are useless).

This work will continue because wild-oat control measures have now been written into all appropriate course programmes.

It is hoped that the advisory/education programme will also continue in order that the current attitudes towards wild-oat control are at least maintained.

10.3 British Agrochemicals Association

The British Agrochemicals Association joined the Programme at the beginning. Member companies sent representatives to each Regional Committee and to the Central bodies. Some member companies undertook a promotional scheme, under the name of Project Panicle, which, whilst not within the administration of the Programme, closely followed its aims and objectives.

The Association believes the Programme achieved its initial aim within the constraints imposed by a low budget and, at the same time, set a precedent in co-operation. The Programme has demonstrated beyond doubt that diverse interests can, by working together, provide a solution to a national farming problem.

On a cautionary note, the Programme has highlighted the necessity of adequate finance and intensive management if co-operative projects of this type are to be successful.

10.4 Home-Grown Cereals Authority

The wild-oat is, without doubt, one of the most serious annual weeds in British cereals production. It adversely affects farm profitability by depressing yields, impairing the marketability of grain and by necessitating additional costs for its control. The contamination of grain with wild-oat also results in additional costs being incurred in cleaning grain and causes particular problems for the seedsman.

The objective of the National Wild-Oat Advisory Programme of reducing the weed to negligible levels in infected areas and decreasing the chance of its ingress and build-up in remaining clean areas, although an ambitious one, was clearly the right one to adopt. During the period in which the programme has been functioning, there has been an increasing awareness among farmers of the importance of controlling the weed and this has been reflected, for example, in a large increase in the use of wild-oat herbicides. In part, at least, this can be attributed to the programme and, in particular, to the stimulus it has given to concerted action by a number of organisations at national and local levels. But, despite the efforts made within the programme, the ultimate object of eradication is still far from being realised and the persistence and vigour of the wild-oat plant will have to be matched by efforts which are no less persistent and vigorous by those who have an interest in controlling the weed, if its eventual eradication is to become a reality.

10.5 Ministry of Agriculture, Northern Ireland

The Wild-Oat Advisory Programme, in Northern Ireland, has to be reviewed in the context of those other measures statutory or otherwise taken during this period. Regulations were introduced under the Seeds Act (N.I.) initially to increase the size of the sample searched for wild-oat, to 1 kg (1971) and subsequently (1974) under an E.E.C. derogation, to require a nil presence in a 3 kg sample. In addition for the production of certified seed the field inspection standards demand a nil presence of wild-oat at the time of inspection. Although the field inspection standard has on occasion caused some problems where a relatively large acreage has been turned down because of the presence of perhaps only one or two wild-oat plants in the field, these two measures have in general been welcomed by those farmers with a long term commitment to intensive production of cereals.

Also in 1971 wild-oat was scheduled as a Noxious Weed under the Weeds and Agricultural Seeds Acts (1909, 1929) and this has allowed directives to be issued to farms with regard to the disposal of straw, and subsequent cropping of the infested area. This has been of benefit particularly for cases of heavy infestation and the fields have in the main been put down to grass. It has also served to emphasize the noxious nature of the wild-oat identifying it in the mind with other established problem species such as ragwort and creeping thistle. Outside of the statutory measures a voluntary Special Wild-Oat Test has been operated by the N.I. Seed Testing Station to allow farmers using their own seed to have a sample tested for freedom from wild-oat for a modest fee.

In Northern Ireland it had been recognised since the first wild-oat infestation from the field was reported in 1966 that any advisory programme could only be effective if the nature and extent of the problem were ascertained. Up to 1971 advisers were asked to report each field infestation to their county headquarters and these were then collated on a provincial basis. Recognising that advisers may only liaise with a small and often select proportion of farmers, surveys based on random samples of cereal crops were commenced in 1971. This surveying has formed a major aspect of the Advisory programme as a whole in Northern Ireland with surveys each year from 1971 to 1977 with the exception of 1976. The general conclusions are that whilst the extent and levels of wild-oat occurrence in Northern Ireland are known with some confidence, farmers awareness is still not adequate. This has been due in large measure to the predominance of infestations at a very low level, and also to the occurrence of Avena strigosa which farmers have tended to accept and indeed dismiss as being of little importance. Of the infestations identified by Department staff in the 1975 survey only one third had been recognised by the farmers. It is clear that roguing and the use of herbicides could be increased. In conjunction with the surveying exercises the advisory aspect was helped considerably by the publications produced during the course of the campaign. The Department of Agriculture in Northern Ireland itself would have been unlikely to have produced such a variety of leaflets and with one or two exceptions these were both relevant and useful. 'Panicle' was particularly successful in the case histories that were presented from elsewhere in the U.K. since with a few exceptions such examples of long term strategic programmes to eliminate wild-oats have not been well documented from within Northern Ireland.

In Northern Ireland the Department of Agriculture was in the main agent responsible for the conduct of the Advisory Programme with the Ulster Farmers Union and commercial interests serving as distribution sources for publicity material. In relation to the organisation of meetings and exhibits it was seldom possible to advertise and devote these entirely to the topic of wild-oat which was normally introduced as an element in the more general consideration of cereal production. There is clearly a limit to which it is possible to maintain the momentum in a programme devoted to 'bad news' such as wild-oat and certain areas which had given this topic good coverage in the initial two years could not continue to do so at the same level for the full five year period.

In conclusion being part of a larger U.K. effort was particularly useful for a region like Northern Ireland where cereal growing is not a major component of agricultural production and momentum was generated which would not have been possible on a purely provincial basis.

10.6 National Association of Agricultural Contractors

Wild-oats cause considerable operational complications to agricultural contractors. For instance, those providing a combine harvesting service find that a heavily infested cereal crop takes longer to harvest than a clean one. Then there is the stigma attached to a machine that has been working in an infested field, which makes some farmers with relatively wild-oat free land unwilling to allow it on their farm until it has been cleaned; a costly and time consuming operation.

Members applaud the greatly increased usage of wild-oat herbicides in recent years which is resulting in a decline in the obvious presence of wild-oat in the worst infested areas. In areas of slight infestation there is still the difficulty of getting growers to appreciate the need for taking all reasonable steps to avoid introducing further wild-oats and of hand roguing low populations. The introduction of wild-oat roguing as a contract service has been possible in Scotland

where a similar service exists for roguing potatoes grown for seed.

For these and other reasons the NAAC has been pleased to participate in the National Wild-Oat Advisory Programme and many members feel it should be continued until wild-oat is eradicated.

10.7 National Farmers Union

The NFU was pleased to have been involved in the five year advisory programme designed to encourage the control or eradication of wild-oats and we believe the Union has contributed much to its effectiveness since a fair measure of control has been maintained in those areas which were most seriously affected. The Union agrees that there is no need to continue the campaign at its previous level. It must be emphasised, however, that there is a need for continuing vigilance since unless attention continues to be given to the problem of wild-oats, even when infestations are relatively small, the whole situation could rapidly deteriorate and again assume serious proportions. For the same reason it is essential that in those areas where wild-oats have not to date been a matter for much concern, infestations could increase to severe levels unless effective action is taken to deal with wild-oats as soon as they are observed to be present. The problem may increase in areas where autumn-sown cereals is being increased. There can be no complacency. The return to cereal growers will have a big influence on the extent to which they feel justified in applying control measures.

10.8 Scottish Colleges

Awareness of the dangers of wild-oats has been well established in the East of Scotland arable areas. College advisers and the Trade can take credit for the promulgation of the programme, the success of which may be gauged by the highest percentage of crops rogued of any area in the UK.

While in the North of Scotland awareness of wild-oats has increased, the problem of persuading livestock farms to control or eradicate non-damaging wild-oat populations largely remains. The local co-ordinating committee met on several occasions but joint events were never organised as the interest of the various bodies were difficult to reconcile. There was a feeling in the north that much of the NWQAP literature didn't reach the farmer.

In the west of Scotland most farmers and some of the Trade had never seen a wild-oat and the programme got off to a slow start. Once co-operation between the Trade and the College was established the message was put across clearly to farmers. 'Panicle' was a great help. The appearance of wild-oats on 'all grass' farms from imported straw highlighted this method of spread.

The programme possibly went on for a year too long, as indicated by the build up of adviser resistance to further campaigning in 1977.

10.9 United Kingdom Agricultural Supply Trade Association

UKASTA valued the opportunity to actively support the work of the National Wild-Oat Advisory Programme in close association with so many organisations all working together for one common purpose. The programme has not only highlighted the growing menace of Wild-Oats in the United Kingdom, but has made the farming and related industries very much more aware of this serious threat to British Agriculture.

What is even more important is the stimulus given by the programme to the need to introduce and use more effective control measures as an essential step towards making the growing and marketing of the Cereal crop more profitable.

11. CONCLUSION

The National Wild-Oat Advisory Programme has succeeded in creating awareness of the heavy financial burden the weed places on the farming industry but the problem still remains.

12. ACKNOWLEDGEMENTS

Grateful thanks are due to all the organisations participating, in particular to the many individuals who played an active part in furthering the aims of the National Wild-Oat Advisory Programme.

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APPENDIX I

CHRONOLOGY OF MAIN EVENTS IN THE ORGANISATION OF THE
NATIONAL WILD-OAT ADVISORY PROGRAMME

- 1972
- 16 February Preliminary ADAS meeting called by Chief Agricultural Officer.
- 6 July Preliminary meeting of representatives from many organisations.
- 30 August First meeting of "Planning Group" (became Executive Group and subsequently met 4 times each year).
- 2 November First full joint meeting of Steering Group (subsequently met twice each year).
- November/
December Regional organisation arranged. Programme literature produced including "Guide to Action" booklet.
- 1973
- 19 February Press conference to launch programme nationally.
- 17 September Meeting of Regional Co-ordinators with Executive Group to establish working relationships.
- 1974
- March Working parties on Combine Harvester Cleaning and Mobile Seed Cleaner Guides.
- 29 April BAA working party on Regional Groups.
- May "Guide to Roguing" leaflet produced.
ATB Course for Farm Sprayer Operators altered to emphasize special needs of wild-oat spray materials. New ATB course on Granule Application and Identification of wild-oat densities and roguing made available.
- Summer ADAS evaluation i) Programme Penetration Survey
ii) Qualitative in-depth interview study.
- 17 October Regional Co-ordinating Groups liaison meeting at Stoneleigh.
- Autumn Revised "Guide to Action" farmers booklet produced.
- 1975
- 10 March Press conference reviewing progress.
- Summer Guide to Cleaning Combine Harvesters produced.

1976

- January Guide to Efficient Use of Mobile Seed Cleaners produced.
- February Meeting Executive Group with Regional Co-ordinating Group Chairman in London. (Review of i. technical advances and research progress and ii. NWOAP progress.)
- Spring Guide to Wild-Oat Herbicides produced.
- March Consortium of chemical manufacturers (Industrial Wild-oat Group) financed a commercial agency to organise a "forceful and dramatic" series of activities to assist the programme.
- September First issue of "Panicke" published.
- October Guide to Cultural Control of Wild-Oat produced.

1977

- Summer National Survey of Wild-oat and Blackgrass (Couch in Scotland) carried out in all regions.
- August Wild-Oat: Guide to Prevention of Spread produced.
- December Preliminary survey report presented.

1978

- 13 February Press conference announcing formal end of programme.

APPENDIX II

NATIONAL WILD-OAT ADVISORY PROGRAMME

REGISTER OF EVENTS: Cumulative Summary June 1973-end March 1978

	4 months	6 month periods to end of										Total
	to Sep 73	Mar 74	Sep 74	Mar 75	Sep 75	Mar 76	Sep 76	Mar 77	Sep 77	Mar 78		
1. Large local field events or conferences (40 or more attending)	8	26	44	26	26	17	21	14	24	8	214 (a)	
2. Small local field events or meetings	95	27	60	41	52	55	47	28	16	13	433	
3. Static exhibits at markets, offices, etc	22	11	15	8	14	10	12	2	6	2	102	
4. Telephone information tape items	-	-	-	-	6	8	23	22	26	11	96	
5. Local press articles, county bulletins, etc	39	32	18	45	48	37	53	27	41	7	347	
6. Local radio programmes	12	15	10	8	22	9	14	13	6	4	113	
7. Regional TV	3	1	2	-	-	-	1	-	-	-	7	
8. County and local shows	7	-	1	-	4	-	5	-	1	-	18	
9. Local surveys	4	-	4	-	3	1	-	-	1	-	13	
10. Circular letters or leaflets	8	5	4	8	16	4	5	3	1	-	54 (b)	
11. Training	3	7	7	13	11	6	1	1	-	-	49 (c)	
12. National events: Wild-Oat Symposium (London) 1974. Wild-oat featured annually at EHF open days at Drayton, Boxworth, Bridgets and Rosemaunde; at WRO open days; at Arable Fair 1974; at Royal Show 1973 and 1975. Project "Panicle"; Smithfield 1976. National Survey of Wild-Oats and other Grass Weeds 1977.												
13. National Press Major articles:												
Farmer's Weekly (continuing series of topical articles)												
British Farmer and Stockbreeder												
Esso Farmer 26 (1) 1974												
Big Farm Management Aug 1975												
Arable Farmer Mar 1976												

NOTES: (a) Majority are well attended small-scale events.
 (b) The figure from March 1975 onwards included a greatly increased coverage within certain areas.
 (c) Does not include the many ATB courses nor Fisons sprayer operator's courses where a brief special mention of wild-oat control features is now included.