The NZAEI NEWSLETTER

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Testing the Performance of Irrigation Sprinklers

Last year Terry Heiler did some work investigating the diameter of coverage and the flow versus pressure performance of various makes of sprinkler heads suitable for effluent disposal. These results were published in the Institute Test Report T/38.

Dave Painter has now begun investigating the distribution patterns thrown by different sprinkler heads. When choosing a sprinkler head the distribution pattern is a very useful characteristic to know. Although the diameter of coverage and the pressure/flow characteristic are important factors in the design of a sprinkler system it is the distribution pattern which determines how uniformly the water will be applied once the sprayline set-distance and the spacing of the heads on the sprayline have been fixed. With the range of drop sizes present and the trajectory, it also determines the way in which wind will affect water application.

To measure the distribution pattern of a sprinkler is however considerably more difficult than measuring the diameter of coverage or the flow/pressure characteristic. At present sprinklers are run in the Still Air Laboratory and the distribution pattern under these still air conditions is measured by the catch in a layout of cans. The experimental results then form part of a computer programme which will work out the uniformity of application of the sprinklers when set at various spacings and in various patterns.

So far this programme has ignored the effects of wind. However if the results are to have a practical use the effects of wind must be taken into account for New Zealand is a notoriously windy country and wind will play havoc with the ideal distribution pattern of any sprinkler. Wind affects the distribution by blowing the spray about and it also causes a certain amount of evaporation so that some water disappears before it reaches the ground. The degree to which wind will affect the spray is influenced by the range of droplet sizes of which it is composed. A fine spray for instance would be more affected by the force and drying power of wind than a spray composed mainly of large droplets, although both will be affected to some extent.

One approach, which may be adopted, is to attempt to predict the patterns laid down with a given sprinkler head and set of wind conditions, and would include information on the effects of evaporation and the varying drag on droplets of various sizes. As can be imagined this results in a very complex combination of variables and the programme necessary to produce results would be a long term one. It would, however, be working towards a general answer which could have wide application .

The other method is to test each sprinkler in operation separately, measuring its performance under various wind conditions as the opportunity offered. This is the approach which, so far, has been reported by overseas workers, and some work to this end is in progress at the Winchmore Irrigation Research Station. While this produces



Investigating the distribution pattern of a sprinkler head in the Still Air Laboratory. The results form part of a computer programme.

some results quickly it takes a very long time to accumulate all the information necessary as the work is dependent on the vagaries of the weather. It also necessitates an extremely large number of tests to provide for all combinations of sprinkler, nozzles, pressure and wind conditions.

As the effort involved in either approach is quite appreciable, the reasons for doing such work must be sound, and other information, for example, crop response and economic considerations must be either available now or likely to be available for use in conjuction with the uniformity data. These factors are being appraised before a detailed testing programme is commenced.



Aerial spraying. The question is: how much of this spray will reach the ground and where and under what conditions? The state of the weather over the first fifty feet is important.

Evaluation of Aircraft Spray Techniques

From August 1969 to July 1970 Professor Wesley Yates of the Davis Campus, University of California, was working with the Institute as a senior research fellow appointed on the recommendation of the Research Advisory Council. Professor Yates has had considerable research experience with spreading of agricultural chemicals from aircraft and was occupied in initiating a research programme into aerial spraying techniques under New Zealand conditions. John Hager, Institute research officer worked with Professor Yates and is now continuing the project.

Shortly after he arrived Professor Yates travelled through New Zealand meeting many of the major agricultural aircraft operators and observing the country over which aerial spraying was carried out. Discussions were held with contractors, agricultural chemical manufacturers and government departments. Out of this discussion the general direction of the project was established. It was decided that the most worthwhile work could be carried out into the evaluation of spray techniques involving high volume application from high release heights. As distinct from much of the aircraft spraying which is carried out at heights of 10 ft or less, little information was available on applications of over say, 10 gallons per acre released at heights around 25 ft and even up to as high as 50 ft. This situation is commonly encountered in New Zealand spraying over hill country or broken country, and also in specialised applications such as forestry operations.

One of the basic differences between low level spraying and high level/high volume spraying is the greater height through which the spray must fall to reach the target area. However this difference, which comparatively is considerable, greatly increases the exposure of the spray to the micro-meteorological conditions existing between release height and the ground.

One of the decisive factors in spraying from aircraft is the weather. Micro-weather is the condition of the atmosphere close to the ground. For a given droplet size and spraying altitude there is a range of micro-meteorological conditions which will allow a satisfactory delivery of the spray. Generally, small droplets are most effective on the target vegetation as they give better penetration and coverage, on the other hand large droplets are much more likely to reach the target. Droplet size measurement is in microns and this refers to the diameter of the droplet. One micron is about one twentyfive-thousandth of an inch making a sheet of newsprint about 10 microns in thickness. Five-hundred micron droplets would look like light rain, while 200 micron droplets approximate drizzle and 100 micron droplets, mist. The life of these droplets, if they are composed of water, which is the most common diluent used in New Zealand, varies according to the size of the drop and the prevailing micro-weather conditions. In still air, at more or less average conditions of temperature and humidity, the approximate life of a 100 micron drop is 16 seconds and that of a 200 micron drop some 63 seconds. A 200 micron drop will fall about two feet a second so that it will evaporate about 40% of its volume falling through 50 ft. A droplet of 100 microns will only fall at the rate of one foot a second and if released at 50 ft will evaporate completely much less than half way down. Droplets of smaller size hardly have time to leave the air-

craft spraying system before they vanish. Air movement, which is always generated by propellor or rotor, aggravates the situation.

Generally speaking, the percentage of spray capable of reaching the target will be governed by the proportion consisting of droplets of less than about 200 microns in diameter. The greater that proportion, the less effective in terms of recovery the spray will be. It must also be borne in mind that no matter what nozzles are used on the delivery system there will be a wide range of droplet sizes present in the spray. However, the percentage of spray which does not actually reach the target under working, as against ideal conditions, will depend on the micro-weather at the time.

Wind present when a spray is released increases evaporation and causes drift. A steady wind which is not too strong can assist spraying by compensating for 'misses' and can increase swath width. However. doubling either aircraft height or the wind speed doubles the drift distance. If the wind is fitful, accurate spraying is difficult and under this condition many spraying operations cannot be carried out.

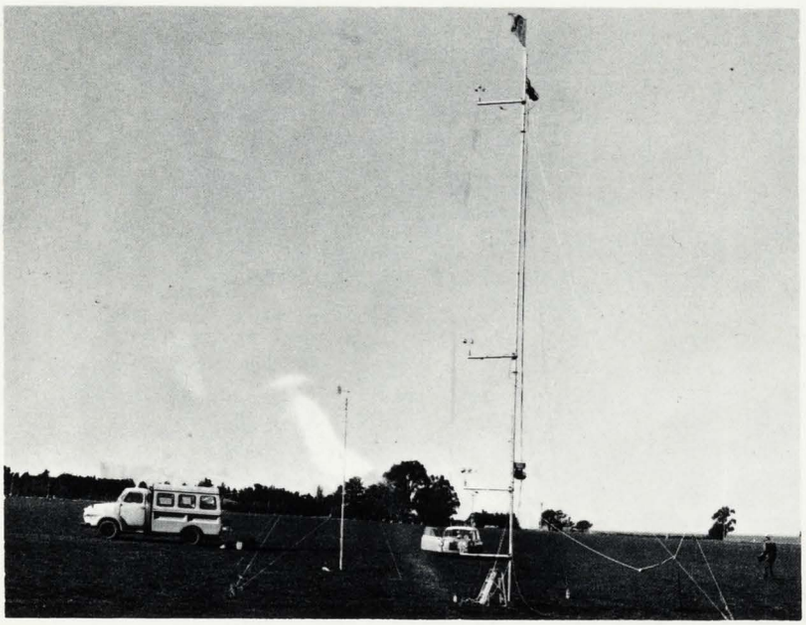
Upward moving turbulence also reduces the recovery rate. The air movement, created mainly by temperature differences and wind, carries fine particles upward where they are lost. That turbulence can have considerable adverse effect is indicated by the facts that a droplet of 100 microns cannot fall against an updraught of two-thirds of a mile an hour, while even a 200 micron drop will be suspended by an updraught of less than one-and-a-half miles an hour.

Whatever average droplet size is decided on, then, it is obvious that the micro-weather conditions existing at the time of spraying are going to play a determining part in the success of the operation. It was decided therefore to begin the programme by conducting a series of routine pattern measurements and measurements of recovery rates while monitoring the micro-meteorological conditions prevailing at the time.

The pattern measurements show the distribution of the spray-fall on the ground while the recovery rates are a measure of spray loss during delivery.

In this way equipment and experience would be acquired and testing and measuring procedures could be established.

In the next Newsletter there will be an account of the way the measurements were made together with a description of the equipment used.



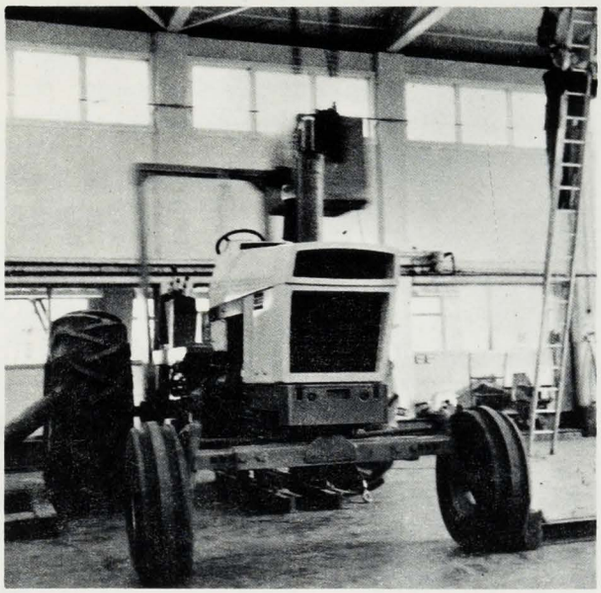
Micro-meteoro'ogical instrumentation set out in the field. Temperature, turbulence and wind are under scrutiny.

Frames for Overweight Tractors

From 30 September of this year all tractors which are to be used for agricultural purposes are required to be fitted with approved safety frames. That is if the tractor weighs not less than 15cwt and not more than four tons.

Tractors outside these weight limits do not legally need to be fitted with safety frames. However, if the owner of a heavy tractor wishes to fit a safety frame then it must be one approved by the Department of Labour which means that it must have been tested and passed by the Institute. As a tractor of over four tons is no more and no less likely to have an accident than one weighing (say) three and a half tons, it would seem to be good practice for the operators of the heavy tractors to fit a safety frame. But unless a safety frame has been tested and approved for use with that particular tractor it cannot be legally fitted and in any case an untested frame is probably worse than no frame at all as it could give a feeling of quite unjustified confidence.

In the case of four makes of overweight tractor the distributors appear to have considered that some at least of their customers might wish to mount frames on the tractors and they have voluntarily submitted tractors and frames for testing. These tractors weighed up to 11750lbs. without ballast. Naturally, the impact test of the frames was of considerable severity and in the case of the heaviest tractor the side blow was equivalent to dropping a two ton weight through a distance of 3ft. In the case of the heaviest tractor to fall just within the weight limit, and this weight included water ballast, the side blow was equivalent to 2 tons dropped through 2ft. 5ins. The greater size and weight of the tractors meant that more strength had to be design-



The moment of impact. The man on the ladder gives some idea of the size of the tractor.

ed into the frames and these factors led to some problems in using the test rig. Because the frames absorbed considerably greater force before beginning to bend the tie down system had to withstand extra strain. As can be seen in the photograph there are two steel joists anchored against the wheels instead of the usual one to minimise tractor movement as a whole. A second difficulty was the necessity to move the suspension point of the pendulum when delivering the blow from the rear. The length of the tractors made this laborious business necessary.

However, the pendulum was raised almost to its maximum to provide the energy to test these frames. If tractors even larger and heavier arrive at the Institute with safety frames to be tested more drastic modifications may be needed so that the rig will be able to deliver the required increased force in the impact tests.

Marie Consedine

In many ways the most important post within the Institute is that of secretary to the director. The girl who holds this position must be much more than an expert shorthand typist, office clerk and receptionist. These requirements are merely the bare bones of the job.

In the first place she is the only girl on the permanent staff of the Institute and must constantly urge and maintain the feminine viewpoint almost unaided among a staff of some two dozen men.

The typing and shorthand does of course contain a proportion of simple letters and notices but most of it consists of scientific papers, student notes and technical expositions. Strange and extraordinary words imbedded in descriptions of technical processes in the fields of water resources, process cropping and mechanical engineering make up the bulk of her work at the typewriter. Much of it appears to have been written by a spider and all of it is complicated by correction and crossing out.

She is also the gateway to the director and must be a model of tact with a well developed social sixth sense.

Of course everyone wants their work done at once, or they all wish to see the director at the same time, or there is some scrap of information which only she can find. So the secretary must be calm—as calm as possible that is. She must always appear happy, smiling and full of confidence even when asked to provide four extra cups of coffee for important visitors and she knows that the milk has run out, or is presented with a bundle of typing with an impossible deadline.

For the past eighteen months this post has been occupied by Marie Consedine who nearly as possible, while remaining attractively human, has possessed all these virtues.

In a few weeks Marie will be leaving the Institute to take up another and perhaps even more challenging position with the V.S.A. in New Guinea. We know that within a few weeks of her arrival at Rabaul, where she will have secretarial duties, she will be as popular and as indispensable as she has been at the Institute.



Marie Consedine—from 13 January her address will be New Guinea.

We are sorry to lose Marie but we are sure that she will be welcome, both for herself, and for the good work she will do in her new position in far away New Guinea and that she will be a valued member of Volunteer Service Abroad.

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