PERFORMANCE EVALUATION OF MICRO-IRRIGATION DEVICES

By

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THESIS

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Declaration

I hereby declare that this thesis entitled "**Performance evaluation of micro-irrigation devices**" is a bonafide record of research work done by me and that it has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of any other university or society.

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CERTIFICATE

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Dedicated to ...

My Beloved Pappa,

who's longing gave me the momentum all the way through

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"In my distress I called upon the LORD, and cried unto my God: he heard my voice out of his temple, and my cry came before him, even into his ears"

(PSALM 18:6)

"Therefore will I give thanks unto thee, O LORD, among the heathen, and sing praises unto thy name"

(PSALM 18:49)

JACOB BIJO DANIEL

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Symbols and Abbreviations

ASAE	American Society of Agricultural Engineers
BIS	Bureau of Indian Standards
cm	centimetre(s)
cm^2	square centimetre(s)
COV	Coefficient of variation
CUC	Christiansen's uniformity coefficient
Da	mean (average) application depth
DC	Distribution characteristic (Merriam and Keller)
Dx	maximum application depth
et. al.	and others
Fig.	Figure
Ha	hectare
hp	horse power
hr	hour(s)
k	kilo
KCAET	Kelappaji College of Agricultural Engineering and Technology
kg/cm^2	kilogram per square centimetre
lph	litre(s) per hour
m	metre(s)
mm	millimetre(s)
mm/hr	millimetre(s) per hour
Pa	pascal
R	radius of throw (wetted radius)
Tab.	Table
%	one hundredth (percentage)
<	less than
>	greater than
Ø	diameter

Introduction

INTRODUCTION

In the areas of inadequate rainfall, irrigation plays a prominent role in promoting higher yields and thus leading to better productive use of agricultural land. Average yields under comparable climatic conditions are generally higher in irrigated conditions than under rainfed conditions. Modern technology inputs for agriculture are productive but costly and therefore create a need for good soil moisture regime to support optimum crop growth and reduced risk of failure. Farmers are becoming more aware of irrigation as a tool for optimising production. When all other management practices are carried out efficiently, irrigation can help the farmers to achieve the top yields and quality demanded in today's market.

In the age-old practice of irrigation an over all efficiency of only 30-35% can be achieved; it also causes water logging, salinity etc. The low efficiency may be accounted for, in part by conveyance losses due to seepage, evaporation and non-beneficial use by pretophytes. The losses are partly the result of non-uniform distribution of water due to inadequate land preparation and lack of proper technique in the application of water, with consequent excess applications and deep percolation.

1.1. Modern methods of irrigation

Irrigation as a modern science is the science of survival. So as to efficiently apply water, advanced methods of irrigation like sprinkler and drip are adopted. Micro-irrigation has proven to be a very efficient irrigation method, in the recent years. By reducing losses and introducing irrigation systems with uniform low application rates, more cultivable land can be brought under irrigation using the saved water.

Sprinkler irrigation is a pressurized irrigation system which tends to simulate the rainfall, in such a way that the runoff and deep percolation losses are minimised and the uniformity of application is close to that which could be obtained under rainfall conditions. This system is very well suited to closely spaced crops, sandy soils where the vertical water distribution is more than the lateral distribution resulting in high percolation and seepage losses and undulating terrains where it is costly to level the land for surface irrigation.

Micro-irrigation is a broad term that includes pressurized micro-sprinkler/ micro-sprayer/ micro-jet and drip/ trickle systems. Solid set high frequency micro-irrigation provides a way to deliver water to fruit trees that has distinctly different characteristics compared to more traditional methods of irrigation. These characteristics have been used to solve specific problems such as high salinity of irrigation water, difficulty in application of fertilizer or pesticide and adjustment of water shortage.

1.2. Micro-sprinkler irrigation

Micro-sprinkler is a low volume sprinkler. Micro-sprinkler irrigation system combines the advantages of the conventional sprinkler system and the modern drip irrigation system. It requires lesser energy than sprinklers and is less susceptible to clogging than drip emitters. It has lower cost of installation than drip system as number of laterals and emitter points are reduced. The cost of micro-sprinkler emitters is very less compared to high-pressure sprinklers. It has much larger area of coverage than drip emitters. In micro-sprinkler irrigation, the plant root system develops evenly due to the larger volume of wetting of the soil than in drip system; resulting in a denser spreading of roots throughout the wetted soil volume. This ensures better supply of water and nutrients to the plant and better anchorage. Micro-sprinkler system has a wide range of applications in fertigation, herbicide application, frost protection, green house and poultry house cooling, etc. The system can be run continuously or intermittently to get the desired rate of application.

Overall system pressure and volume of flow of micro-sprinkler irrigation system will be higher than that of drip irrigation system. It is now possible to incorporate small flow regulators into micro-sprinklers that convert each sprayer into a pressure compensated outlet. This can reduce the application rate and system cost and can deliver better uniformity of irrigation.

1.3. Uniformity of irrigation

Ideally, an irrigation system should apply water in a completely uniform manner so that each part of the irrigated area receives the same amount of water. Unfortunately, there seems to be no present way to achieve this. Even natural rainfall is not completely uniform. So the phrase "irrigation uniformity" actually refers to the variation, or non-uniformity, in the amounts of water applied to locations within the irrigated area. Significant effort in irrigation system design and management is directed towards dealing with problems related to irrigation uniformity, or the lack of it.

A micro-sprinkler with water distribution uniformity below acceptable levels will produce over-irrigated and under irrigated areas within its wetted area. This will lead to deep percolation and runoff losses from the over-irrigated areas and may cause water stress for the plants in the under irrigated areas. Studies showed that the optimum irrigation amount, crop yield and engineering costs related to a micro-irrigation system are dependent on the irrigation uniformity. In order to make economically sound micro-sprinkler irrigation design decisions, it is important to be able to measure and predict the uniformity of application.

Irrigation uniformity is also inherently linked to the efficiency with which agricultural resources are used. Since non-uniformity results in the application of excess water, several water-related resources are also lost. These include: energy for pumping the excess water; fertilizers; either applied with the irrigation water or leached by the excess water; other chemicals which may be applied with or washed away by the water; and capital losses due to the extra capacity designed into the irrigation and drainage systems to carry the excess water. As non-uniformity causes crop yield to fall below potential levels, agricultural inputs applied in anticipation of full yield are also wasted.

1.4. Evaluation of devices

High uniformity is important for proper irrigation, especially on sandy soils where the lateral re-distribution of water is limited. Excess application of water on these soils often results in deep percolation of water and leaching of nutrients out of plant's root zone. High uniformity in application is necessary for fertigation and chemigation.

Usually manufacturers of micro-sprinklers are providing very little information about their sprinkling devices. This makes the selection of micro-sprinklers and their operating conditions difficult, during the design of an irrigation system. Most of the micro-sprinklers now available in the market are seldom tested by someone other than the manufacturers. Usually the manufacturers give only the discharge and radius of throw of the emitters at different pressures.

The examination of micro-sprinkler water distribution pattern is required for development of new prototypes, manufacturer's quality control and sprinkler evaluation by consumer organizations. The last two applications, in particular require routine testing of a large number of sprayer - pressure combinations. Uniformity is an indicator of the equality (or inequality) of the application rates within the pattern diameter of an emitter.

The devices should be tested before field installation to verify the quality of the emitters. Moreover, such tests will help the manufacturers to improve the design (and thus performance) of their products and the end users will get a general guideline for the selection of such products. The information on the effects of operating pressure on uniformity and flow rate is vital for designers and operators of micro-irrigation system to enable a perfect match of emitter performance to the soil and crop irrigated.

Objectives

The objectives of the present study may be listed as follows,

1. To analyse the pressure-flow rate relationship of different micro-irrigation devices.
2. To determine the different performance parameters of the emitters with respect to the uniformity of application.
3. To analyse the distribution pattern of various emitters operated at different operating pressures.
4. To analyse the various performance parameters to determine the relative performance of the emitters and to analyse the credibility of manufacturers claim.

Literature Review

REVIEW OF LITERATURE

Farmers have always sought ways to supply the crops with water necessary for their development, when rainfall was inadequate. Rapid increase in the world population has made the efficient use of irrigation water vitally important, particularly in poorer countries, where the greatest potential for increasing food production and natural income is often through irrigation. Therefore it is necessary to adopt effective irrigation methods that are economically viable, technically feasible and socially acceptable. Micro-irrigation falls under this category, especially for widely spaced high value crops like coconut, grape, orange, citrus etc. and commercial crops like sugarcane, cotton, ornamental plants etc.

2.1. Micro– irrigation

Micro–irrigation is the frequent application of small quantities of water directly on or below the soil surface. Usually water is applied as discrete drops, continuous drops, tiny streams or miniature spray through devices placed along a water delivery line (BIS, 1987 a).

Micro–irrigation may be described as a method of applying low volumes of water directly to the root zone of the crop and limiting it to the root spread volume of the soil layer. Micro-irrigation systems are typically designed to wet only the root zone and maintain this zone at or near an optimum moisture level (James, 1988).

2.1.1. Classification

Micro–irrigation systems include low pressure, low volume irrigation systems and can be subdivided in to four main methods according to pressure and volume (Barret, 1979). Drip irrigation applies water directly to the soil surface or subsurface and allows the water to dissipate under low pressure in a pre–determined pattern. The other three methods viz., Mist, Sprayer and Mini sprayer methods that convey water through the air can be termed as micro-sprinkler systems. The wetted area of these emitters is small, can be controlled fairly easily and has different shapes to match the desired distribution patterns.

Micro–irrigation spray and spinner emitters were characterised by Post *et al.* (1985) as devices having operating pressure less than 2 kg/cm^2, discharge rates in the range of 20 to 100 lph and throw diameters ranging from 1.5 to 10 m. Losses due to surface evaporation and deep percolation are avoided in this method. The system is limited to water scarce areas and is largely confined to fruit crops, plantation crops, widely spaced vegetables etc. (Walker and Skogerboe, 1987)

2.2. Evolution and development of micro-irrigation

The concept of micro-irrigation though simple, was not practiced widely until very recently due to lack of economic materials. The first experiments leading to the development of micro–irrigation were introduced by German researchers in 1860. They pumped irrigation water in to short clay pipes with open joints used for under ground drainage, to maintain a water table near the plant root zone. In the 1920's porous pipe and canvas was used for subsurface irrigation at Michigan State University, and subsequent experiments were centred on development of perforated pipes made of various materials and on control of flow through the perforations (Bucks and Davis, 1986).

2.2.1. Trickle irrigation

The discovery of high-density polyethylene (HDPE) in 1948 made the break through for micro-irrigation. A significant step in the evolution of trickle irrigation took place in Israel in the late 1950's when long path emitters were greatly improved. By the early 1960's plastic pipe micro–irrigation systems were being used extensively in greenhouses in most commercial enterprises. Drip irrigation was first tried on a commercial scale for vegetables in Israel, in

1960's in the Arava Valley. In 1969, the first research and demonstration study of micro-irrigation was initiated on an avocado orchard in California (Gustafson *et al.*, 1974). Around that same time, field trials were conducted using surface micro-irrigation on strawberries and tomatoes, also in California (Hall, 1985).

It soon became apparent that drip irrigation almost doubled the yields. The large scale and commercial use of micro-irrigation began in the late 1960's and early 1970's. Numerous inventors and companies began developing drip irrigation emitters, and by mid 1970's well over 250 emitter devices were being marketed.

The interest of micro-irrigation was most keen in Israel, USA and the Middle East since these areas have traditionally suffered shortage of irrigation water.

2.2.2. Micro-sprinkler

Micro–sprinklers are small volume sprinklers that operate at low pressures. The concept of micro-sprinklers was materialized in the beginning of 1980's as an improvement over the drip irrigation system, by replacing the trickle emitters by low volume, low pressure sprinklers in the drip irrigation network. They have been introduced to the world of irrigation by fusion of the peculiarities of drip irrigation and sprinkler irrigation methods.

Although sprinkler irrigation and drip irrigation methods are adaptable means of applying water to any crop, soil and topographic conditions, each of these methods has its own demerits also. The micro-sprinkler system combines the merits of both the systems and avoids most of the demerits.

Micro-sprinkler irrigation is a versatile means of applying water. The design principles are similar for micro-sprinkler and the trickle systems (Cuenca, 1989).

Demand for the micro-sprinklers increased greatly when it was found they could provide frost and freeze protection. New citrus planting during and after the severe freezes of the 1980's made Florida one of the fastest growing markets for micro-sprinkler irrigation between 1985 and 1990. (Smajstrala, 1995)

2.3. Growth of micro–irrigation

A survey conducted by the International Commission on Irrigation and Drainage (ICID) indicated that about 1,770 kHa were under micro-irrigation through out the world (Bucks, 1995). The largest use of micro-irrigation was in the United States, where the area has expanded from approximately 4 kHa, in 1972 to over 1 million Ha, in 1994.

There has also been extremely rapid growth in Spain, where the micro irrigated area has increased from 10 kHa, in 1975 to 160 kHa, in 1994.

The main reasons for converting to micro-irrigation were indicated as follows: (1) water and labour were expensive (2) the water supply was limited (3) the water supply was saline (4) the use of conventional irrigation methods was difficult especially in hillside orchards. (5) landscape and greenhouse irrigation required water conservation and (6) improved yield or quality demand, which could only be satisfied with use of micro–irrigation methods (Anonymous, 1995). Application of micro–irrigation for landscaping, greenhouses and nurseries has also increased tremendously and includes ornamental trees and shrubs, ground covers on highway road sides and residential properties, citrus nurseries, forestry trees and others.

2.3.1. Status and scope in India

The farmers of the country are convinced of the usefulness of the system, and the system has emerged as a suitable water-saving and production augmenting technique, especially for widely spaced high value crops in water scarce, undulating sandy or hilly areas. Although research and demonstrations of the system have been in progress from 1970, large-scale adoption has taken place only for last 10 or 15 years (Sivanappan, 1998).

The development of micro-irrigation in many states is very spectacular due to the encouragement provided by the government and promotional efforts by the manufacturers.

The farmers are forced to take up the system since water has become scarce commodity in the states of Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Gujarat and Rajasthan. For example, in Kerala, the coconut and other plantation crops need water during the dry period of January to May and the farmers are installing micro irrigation systems to manage the shortage of water. They are now convinced that the systems help to get more yields with less input, apart from saving of water.

2.3.1.1. Adoptability constraints

The difficulties experienced in bringing large areas under this method are high initial cost, clogging of the devices, lack of adequate technical knowledge and inputs, high cost of spares and components and insufficient extension efforts.

Puranic and Gaonkar (1992) investigated the constraints and problems of micro–irrigation systems for both adopter and non-adopter farmers. Major constraints to adoption included heavy initial investments, lack of knowledge support, cost and time involved in the maintenance of the system etc. The author suggests that extension agencies, concerned departments and manufacturers must all concentrate on alleviating these problems.

2.4. Advantages and disadvantages of micro-irrigation

Micro-irrigation has advantages and disadvantages, the system must be tailored to specific field and water conditions before success will be achieved. Careful attention to irrigation system design and management can make the most of these advantages and often can compensate for the disadvantages as well.

2.4.1. Advantages

Obvious advantages of micro-irrigation include a small wetted surface area, minimal evaporation and weed growth, and potentially improved water application uniformity within the crop root zone by better control over the locations and volume of application (Hoffman and Martin, 1993).

The benefits of using micro-irrigation can be listed as,

1. Low application rates - frequent light irrigation or controlled supplementary irrigation - minimal runoff and seepage losses.
2. Higher uniformity of water application - increased efficiency.
3. Exact water placement through the network – reduced weed growth.
4. Controlled root zone environment – reduced overall water requirements.
5. Successful performance in difficult terrains/ rolling topography.
6. Suitability to problem soils and improved tolerance to salinity.
7. Water and energy conservation.
8. Improved chemical application – fertilizers, pesticides etc. can be applied along with the irrigation water itself.
9. Maintenance of optimum soil moistures levels – increased yield and improved quality of products.
10. Diversified uses (Irrigation, greenhouse/ poultry house cooling, frost protection etc.)
11. Ease of automation - less labour requirement and improved precision of irrigation scheduling.

2.4.2. Disadvantages

Micro-irrigation has several disadvantages, which can often be overcome by proper system design and management. Individuals considering micro-irrigation should weigh the economic cost against the economic benefits.

Micro-irrigation systems require more maintenance than traditional irrigation systems. The small water flow passageways characteristic of micro-irrigation systems can easily plug. Proper preventive measures can minimise or eliminate this disadvantage. The quality of the irrigation water may affect the micro-irrigation system. The type of water quality problem is somewhat dependent on whether the irrigation water comes from a surface source or a well. In both cases, adequate filtration and chemical treatment is required to prevent emitter plugging. If the source of water is a well, chemical precipitation is the most common problem. If the irrigation water is from a surface source, biological plugging is the most common. Nakayama and Bucks (1986) gives an account of the disadvantages of micro-irrigation compared to conventional systems.

However, micro-sprinkler systems have less clogging problem compared to drip irrigation systems due to the higher pressure of operation, bigger orifice sizes and mechanical movement.

2.5. Micro-sprinkler irrigation system

Micro sprinkler is a small sprinkler that works under low operating pressure, sprinkling low volume of water at a low rate that is allowed to fall back either on the canopy or soil surface, covering part of the area allotted to each plant. Here the distribution of water occurs through the medium of air compared to drip and bubbler irrigation where the distribution occurs due to the water movement through the soil.

Spray or spinner micro sprinklers are often preferred over drip systems since they provide a larger diameter wetting pattern. This characteristic is especially desirable in areas with coarse textured soils where lateral movement of water in soil is limited (Boman, 1989). The greater coverage diameter allows a larger percentage of the root zone to be wetted by the irrigation and can result in greater soil moisture reserve and better root development. The larger wetting patterns of spinner and spray emitters also provide advantages when the irrigation system is used to apply herbicides and fungicides or fertilizer.

Micro–sprayer emitters have low precipitation rates, which typically are, less than 4 mm/hr. Thus by applying the right amount of water at the correct irrigation rate, there will be no seepage beyond the root zone, nor the problem of decreased aeration in the root zone, caused by water logging (Chaya and Hills, 1991).

In situations where root system develops according to the natural rainfall, only the micro-sprinkler irrigation system, with its modular design and wide range of operation, is capable of supplying the required quantity of water and nutrients accurately and efficiently to the already developed root system. Considerable saving in water will result in going for micro-sprinkler irrigation system. They wet only 40 to 80% of the soil surface in a mature orchard. The area wetted by the micro-sprinkler can be adjusted according to the development of the root system.

2.5.1. Adaptability

Besides the adaptability over a wide range of soil, crop and topographic conditions, some other objectives that can be attained using micro-sprinklers are,

1) Effective use of small, continuous streams of water such as from springs and small tube or dug wells.
2) Proper irrigation of problem soils with inter-mixed textures and profiles or the irrigation of shallow soils that can not be graded without detrimental results.
3) Irrigation of steep rolling topography without producing runoff or erosion.
4) Effective, light and frequent watering may be possible whenever needed.
5) The micro-sprinklers are highly adapted to water sensitive crops where wetting of upper portion of the plant is undesirable.

Davies *et al.* (1988) details the special adaptability of micro-sprinkler systems to difficult situations.

2.5.2. Comparison

The concept of micro-sprinkler was made by fusing the advantages of conventional sprinkler and modern drip irrigation system. The micro-sprinklers are generally used for under-tree sprinkling in orchards and for widely spaced crops. The wind drift losses are very less compared to conventional sprinkler system due to shielding by the canopy and lesser wind velocities near the ground.

In conventional sprinklers, large droplets having higher kinetic energy disrupt the soil surface causing reduced infiltration rate due to crusting (Dadiao and Wallender, 1985). This does not occur while using micro-sprinklers, thus preventing losses by runoff, and they apply the right quantity of water only, so that no anaerobic condition is developed within the root zone.

Compared to other methods of irrigation (conventional surface irrigation methods) the micro-sprinkler system has proved to be efficient, water, energy and labour saving, trouble free and economical. Saving due to micro-sprinkler is reported to be the extent of 30 to 60% over traditional methods of irrigation (Mane *et al.*, 1987 and Bankar, 1992). This is due to the partial wetting of the soil volume, reduced runoff and controlled deep percolation losses. The water use efficiency reported under micro-sprinkler system was well above of that under other systems evaluated (Shinde, 1995).

The micro-sprinklers are generally operated at a pressure range of about 1-2 kg/cm^2 (100 to 200 kPa), which is very low as against the high pressure operation of conventional sprinkler systems and comparatively high as compared to the operation of drip irrigation systems. Obviously, considerable saving in pumping energy can be attained with micro-sprinklers over conventional systems. The combined effect of larger nozzles (as compared to the tiny openings and small water flow passageways of drip system) and higher-pressure operation minimises the chance of clogging. Thus use of expensive and sophisticated filtration equipments may be avoided except for highly sedimented irrigation water. Singh and Singh (1990) states that micro-sprinklers require lesser energy than conventional sprinklers and are less susceptible to clogging compared to drip emitters.

The canopy to active root ratio is much better under micro-sprinkler than drip irrigation system. Roots of the drip-irrigated trees are concentrated in a shallow, small volume of soil under the dripper, where as a large number of roots penetrated to depth of 70-80 cm in areas irrigated by micro-sprinklers.

Since visual inspection of the micro-sprinkler system is simple and fast, less time is required than for the inspection of several emitters per tree in a drip irrigation system. Micro-sprinklers are also superior to other systems on marginal land and for the use of marginal or saline irrigation water.

The only obvious disadvantage associated with micro-sprinkler irrigation system, as compared to the drip system, is the enhanced weed growth caused by the larger area of wetting, which can be solved by the use of herbicides along with irrigation water.

2.6. Irrigation efficiency

Irrigation efficiency indicates how efficiently the available water supply is being used, based on different methods of evaluation. The design of the irrigation system, the degree of land preparation, and the skill and care of the irrigator are the principal factors influencing irrigation efficiency (Michael, 1978). Loss of irrigation water occurs in the conveyance and distribution system, over the field by non-uniform distribution of water, below crop rootzone by percolation; and with sprinkler irrigation, by evaporation from the spray and retention of water on the foliage. In case of large fields loss may occur by runoff at the end of irrigation borders and furrows. The losses can be held to a minimum by adequate planning of the irrigation system, proper design of the irrigation method, satisfactory land preparation and efficient operation of the system.

In micro-irrigation system no conveyance losses occur since the irrigation water is conveyed through pipes. Losses due to runoff, percolation and evaporation are less, due to low application rate and precision application. In the case of micro-sprinkler system the wind-drift losses and evaporation from foliage is very less due to under the canopy operation. So the irrigation efficiency can be expressed as the application efficiency (ratio of the amount of water applied to the root zone to the amount discharged by the system). Thus for a micro-sprinkler irrigation system, the irrigation efficiency will depend up on the degree of uniformity with which the emitter delivers water to the irrigated/ wetted area.

2.6.1. Irrigation uniformity

An important component of the evaluation of the irrigation performance is the measurement of irrigation uniformity. Specific quantitative study of sprinkler irrigation uniformity began with the pioneering work of Christiansen in 1942.

Studies show that the optimum irrigation amounts, crop yield and engineering costs related to a micro–irrigation system are dependent on the irrigation uniformity. The level of irrigation uniformity can be used as an indicator to describe the performance of the irrigation system. Chen and Zhen (1995) determined the importance of irrigation uniformity in the design of micro-irrigation system by analysis the relationship between crop yield and water consumption and between irrigation uniformity and engineering costs.

2.6.1.1. Agronomic importance

As Burt (1998) points out, if a volume of water applied to a field is known only as the average applied over the whole field, then one half of the field has received less than the average applied and the other half, more than the average applied. Insufficient water leads to high soil moisture tension, plant stress and reduced crop yields. Excess water may also reduce crop yields below potential levels through mechanisms such as leaching of plant nutrients, increased disease incidence or failure to stimulate growth of commercially valuable parts of the plant. Thus a major aim of irrigation management should be to apply water with a high degree of uniformity while keeping wastage to a minimum.

The ability of a micro-sprinkler system to apply water uniformly throughout the irrigated area is a major factor determining whether or not proper crop growth can be maintained.

2.6.1.2. Engineering importance

Significant effort in irrigation system design and management is directed towards dealing with problems related to irrigation uniformity, or lack of if. A non-uniform irrigation unavoidably results in some degree of under and over watering. Hence, if the average volume applied is the target application required to meet the crop requirements, one half of the field has been over-irrigated, reducing the efficiency of application, while the other half of the field has been under-irrigated, reducing yield.

Since irrigation uniformity relates to crop yield and efficient use of resources, engineers regard it as an important factor to be considered in the selection, design and management of irrigation systems (Solomon, 1988).

2.6.1.3. Economic importance

Kunde (1985) compared investment costs, water costs and power costs for nine micro-irrigation designs. Initial investment costs increased with uniformity, while water and power costs decreased. The water and power cost savings were more than enough to payback the increased cost of higher uniformities. In agricultural areas with higher water and power costs, the savings due to improved efficiencies would be even higher.

2.7. Performance evaluation

In a purely volumetric sense, the efficiency of the system should be determined as the ratio of the water used by the plant to the water input. While the ultimate volumetric output of the irrigation system is the water used by the plant, the output product from the whole farming system is commonly viewed as the marketable crop of economic returns. While it is possible to argue that the efficiency of water should not be defined in terms of crop yield produced or value obtained, such gross indicators are of most practical interest to commercial irrigators (Dalton and Raine, 2000).

Since irrigation uniformity is an important component of the evaluation of in–field performance and the determination of application efficiency often involves the crop yield produced or value obtained at the farm level; the performance of single non-overlapping micro-sprinkler systems can be evaluated on the basis of irrigation uniformity measures, in a purely technical sense. The performance of micro-irrigation is heavily influenced by the uniformity of application. Since the uniformity of distribution of irrigation water applied by a micro-sprinkler is the primary factor that determines the application efficiency, a measure of the distribution uniformity can better describe the performance of the system.

2.7.1. Catch-can test

The technique of catch-can testing is the suitable method for the performance evaluation of spray-type irrigation systems. ASAE (1991), ASAE (1997) and BIS (1987 a, b) describe the general procedure of catch-can testing and other standard methods of testing of sprinkler systems.

The performance of micro-sprinkler systems has been assessed commonly using catch-can methods with the cans placed in full wetted area or part (one quarter) of the wetted circle (Boman, 1989; Pandey *et al.*, 1995 b; Post *et al.*, 1985).

2.7.2. Performance indicators

A large number of indices for the assessment of irrigation performance have been proposed. Willardson (1972) stated that at least 20 definitions of irrigation efficiency existed at that time.

It is difficult to adequately evaluate irrigation performance using a single parameter. Hart (1972) suggests that it is necessary to use three efficiency terms and one distribution uniformity term to adequately describe the hydraulic performance of an in-field irrigation system. However, Walker (1993) used two efficiency and two uniformity indices while Connellan (1994) used only one efficiency and one uniformity term. At the system or whole farm level, a range of performance parameters may be appropriate depending on the spatial and temporal boundary conditions established for the evaluation (Dalton and Raine, 2000). Many irrigation workers and manufacturers of irrigation equipments use only a single term.

Different performance indicators (dimensionless coefficients) are used to describe the individual performance of micro-sprinkler. A wide range of irrigation uniformity coefficients are commonly used in performance evaluation (Jensen, 1983). The different coefficients and methods used for the evaluation of the performance of micro-sprinkler are uniformity coefficient, (UC), distribution uniformity (DU), coefficient of variation (COV), distribution characteristic (DC), distribution pattern (or densogram) and scheduling coefficient (SC).

2.7.2.1. Uniformity Coefficient

One of the basic measures of any irrigation system's performance is Christiansen's (1942) uniformity coefficient, CUC. Christiansen defined the uniformity coefficient as,

$CUC = 1 - (D/M)$; where D in the average absolute deviation of irrigation amounts, and M is the average irrigation amount.

Although some modifications are also suggested to this relation, CUC is still used as a powerful tool for evaluating the performance of irrigation systems. The modification suggested (which incorporate the standard deviation of the irrigation amounts) are UCW and UCH.

$$UCW = 1 - (S/M) \text{ and}$$

$$UCH = 1 - (0.798\ S/M)$$; where S in the standard deviation of irrigation amounts.

One of the limitations of the CUC calculation is that it treats under-watering and over watering the same.

2.7.2.2. Coefficient of Variation

The coefficient of variation, COV of application depths for a particular emitter is calculated by dividing the standard deviation of the depths by the mean of the depths. Since COV is a measure of the deviation of individual depths compared to the average depth, higher values of COV describe poor performance of the system and vice versa. COV is expressed as a percentage.

Boman (1989) evaluated several micro-irrigation emitters to determine their uniformity of distribution. The coefficient of variation of catch depths was selected as the primary performance indicator for the study. The author states that the COV is independent of the scale of measurement, and thus allows dimensionless comparison of variability for emitters with different flow rates. The COV values less than 100 can be considered as good water distribution and values over 200 indicate patterns that have a large portion of the effective area that receive no water. These high COV's may also signify that the pattern has areas with very high application depths relative to the mean.

2.7.2.3. Distribution Uniformity

The distribution uniformity coefficient (DU) is also widely used for spray systems. It takes into account of the variation of can readings from the mean but concentrates only on the lowest 25% of the readings. The range of DU values for sprinkler distributions will be similar to CUC; however, due to method of calculation, DU will generally be lower. For example, for a system with CUC of 85%, DU will be approximately 78% (Connellan, 1994).

The distribution uniformity coefficient is usually used by turf engineers who often combat with dry spots in the irrigated area, rather than well-watered or wet spots. The use of the 'lowest 25%' is purely arbitrary and bears no relationship to the crop's growing characteristics.

2.7.2.4. Distribution Characteristic

Unlike impact sprinklers, micro-irrigation emitters generally are located in the field with non-overlapping patterns on widely spaced plants. Merriam and Keller's (1978) distribution characteristic (DC) is the standard method for evaluation for non-overlapping sprinklers. The DC is defined as the ratio of the area that receives more than half of the average application to the total wetted area, expressed as a percentage. The authors suggested that DC value greater than 50% are probably satisfactory and that very good patterns result with DC values greater than 66%.

Although DC is the standard method for evaluation for non-overlapping sprinklers, other methods are also used either singly or in combination with one another. Post (1986) recommended using additional performance indicators in addition to DC in order to better characterise the emitter performance. The coefficient of variation was the indicator suggested by him.

2.7.2.5. Scheduling Coefficient

The scheduling coefficient, SC is a number that relates to the uniformity of coverage and how to operate the system to adequately irrigate the whole area, often used by the turf engineers for over-lapped patterns. Determination of SC requires costly computer software like *SPACE* (Sprinkler

Profile And Coverage Evaluation) or *Hyper-SPACE* which uses a sliding window technique to cover the sprinkler pattern area. The software averages the application values falling within the window. The window-averages are then reviewed to identify the driest window, and then the runtime of the system is increased such that adequate irrigation (amount equal to the mean depth or the target application) is provided to the driest window of the coverage area.

2.7.2.6. Distribution pattern and densogram

The distribution pattern or spray coverage pattern is formed by a collection of curves (isograms) plotted by connecting the interpolated points of equal application rates within the wetted area. This gives a rough idea of how the emitter applies water to the irrigated area. A good emitter should produce circular isograms of decreasing application rates from centre to outer perimeter of the wetted area.

Christiansen (1942) was probably the first to point out the significance of distribution pattern in assessing the performance. The distribution pattern of a sprinkler gives water application rates (or depths) as a function of the radial distance from the sprinkler. The distribution pattern is affected by the combination of nozzle and pressure as well as the sprinkler model itself.

The 'densogram' is a modification to the distribution pattern. This involves the shading technique to represent the varying application rates. The densogram gives a good visual impression of distribution of irrigation water (as well as overall uniformity of application); it does not provide quantitative way to actually measure the uniformity.

A non-quantitative way to look at the wetted area is to have it graphically displayed using a shading technique. This process transforms the actual catch values into various intensities of shades. The dot matrix printer shading technique used by Centre for Irrigation Technology, Florida is to transform the application rates to different intensities/ densities of dots. The wettest area is displayed as black (solid dots); all other application amounts are scaled between black and white (white represents area receiving no water or the dry spot) with corresponding shades or densities of dots. The resulting densogram gives an excellent visual description of where the high and low watering spots are, how wet or dry they are; and in general, how uniform the water application is.

The feel of over all uniformity of water application; for every emitter, can be produced by giving various shades to different application depths. The individual application depths can be transformed to values represented as percentage of average application depth. Since they are represented as percentage of the average application depth of the corresponding emitter, the emitters can be easily compared for their performance. The densogram will show how much a particular area over-irrigated or under-irrigated as compared to the targeted application rate (corresponds to average application depth, i.e. 100%).

Boman (1989) has evaluated several micro-sprinklers to determine their individual performance. He reported that the application rate of several micro-sprinklers was not very uniform. Some emitters put out a 'doughnut' pattern where more water is thrown to the outside and less remains near the centre (an increase and then decrease in application rate from centre to outside). Distribution patterns of a number of micro-sprinklers are shown, to clearly describe their performance. Only one of the emitters tested had a DC value greater than 50%. Apparently, low DC values (less than 50%) are typical for micro-irrigation sprinkler and spray emitters. The average COV values for the spray emitters tested were 181, 165 and 167, and for the spinner emitters were 101, 71 and 73 respectively for the 103, 138 and 172 kPa tests. The higher COV values in the 103 kPa tests were due to a more pronounced doughnut effect in some of the emitters at the lower pressure. This problem is common for high-pressure sprinklers that are operated at too low a pressure.

Pandey *et al.*(1995 a) determined the performance parameters such as average application rate, absolute maximum depth and coefficient of variation by single nozzle test for five makes of micro-sprinklers, designated for reference as A, B, C, D and E. The range of mean depth at varying pressures and heights for micro-sprinklers A, B, C, D and E respectively were found to be 6 to 2 mm, 6 to 4 mm, 16 to 5 mm, 3 to 2 mm and 9 to 2 mm and the range of COV were found to be 254 to 76, 207 to 90, 189 to 66, 199 to 105 and 215 to 63 respectively.

2.8. Effect of pressure on distribution uniformity

The operating pressure is one of the main factors influencing the distribution uniformity of a micro-sprinkler system. The operation of a micro-sprinkler system at a very low or very high pressure (compared to the optimum/ recommended operation pressure) will result in poor uniformity.

Post *et al.* (1985) reported that most of the emitters tested had no appreciable difference in its DC when operated at the three testing pressures, but coefficient of variation has shown remarkable variations.

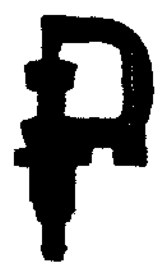
Boman (1989) reported that a slight drop in the operating pressure (from 138 kPa to 103 kPa) has caused a sudden increase in COV of all the emitters tested. The COV of some emitters more than doubled with this pressure drop. The development of a doughnut pattern was also observed, when the operating pressure was dropped. At 172 kPa most of the emitters have shown very good performance, at 138 kPa, beginnings of a doughnut pattern near the outer perimeter of the distribution pattern was observed. The emitters when operated at 103 kPa, has produced a pattern with a well-developed 'doughnut'.

2.9. Management of the irrigation system

Improved irrigation system hardware or management may result in greater distribution uniformity and improve the potential for higher application efficiency. It follows that distribution uniformity is the first concern when improving irrigation system performance.

Achieving high application efficiency ultimately depends on the management of the system. (Hermanson and Canessa, 1995)

Responding to the increased demand, new developments have made many more brands of micro-sprinklers and spray patterns available. A number of manufacturers have introduced new emitters to the market. Today, growers have an extensive choice of emitters that vary widely in output discharge, spray diameter and spray patterns. This large selection of emitters is beneficial but the growers may be unaware of the performance capacity of the emitters. Accurate information on the efficiency/ uniformity of various patterns produced by the emitters is very essential for better designs of irrigation systems and for good irrigation management. When selecting a nozzle, the grower should insist on seeing the information regarding the performance (irrigation efficiency or uniformity of application) and should look for a brand/ model that have a relatively flat emission with distance from the emitter.



Materials & Methods

MATERIALS AND METHODS

This chapter gives an account of the various materials used as well as the methodology adopted for achieving the objectives of the present study.

3.1. Evaluation of micro-irrigation emitters

The general test conditions and equipments are detailed in this section.

3.1.1. Location

The present study was aimed at evaluating the performance of various micro-sprinkling devices; including the analysis of distribution pattern and uniformity of application of the irrigation devices. Since such experiments require a windless condition, the present study was conducted inside the SWCE (Soil and Water Conservation Engineering) laboratory, K.C.A.E.T., Tavanur. The place is in Malappuram district, situated at 10°52'30" North latitude and 76° East longitude.

3.1.2. Experimental setup

The area selected inside the laboratory for the present study was cleared and boundaries were marked. The floor surface was level so that the micro-sprinkler when mounted over the stake remained vertical. The source of water was a water tank fitted with a float mechanism to ensure a fixed water level in the tank throughout the experiment. Water was filtered before collecting in the tank.

A centrifugal pump (1 HP, 50 m of total head) operated by an electric motor was used to create the necessary pressure to operate the emitters. The main line was constituted by 32 mm ø PVC pipe and the lateral by 16 mm ø LDPE tube. Three gate valves connected to the delivery line of the pump were used to control the discharge from the pump and a pressure gauge was used to monitor the pressure head applied. A pressure gauge of 0 - 4 kg/cm^2 (± 1%)

was connected to the mainline such that it indicated the pressure head near the base of the emitter at a point situated about 20 cm below the nozzle of the emitter; but with the gauge situated in the same plane as the emitter. The Plates 1(a), (b) and (c) show different views of the overall experimental setup.

3.1.3. Emitters

The number of micro-sprinkler models selected for the present study was ten. The emitter samples were randomly selected, by choosing few numbers of each of the ten different models (from the supplier's lot). They could be identified by the general appearance (design/ structure) of the emitter and the colour of the nozzle (The data provided by the manufacturers are given in Appendix I). The emitters were categorised to three general types, viz. single jet self thread type (ALBL, ALGR, ALRD), single jet adapter type (JNBK, JNBL, JNGR, JNWH) and double jet type (D-BR, D-LG, D-NG) - three models each from single jet self thread type and double jet type and four models from single jet adapter type. Plate 2 shows the emitters in assembled condition and Plate 3 shows them in exploded condition; the micro tubes, connectors or adapters provided are not shown.

The design of single jet self thread type emitters was such that they could be connected directly to a PVC pipe, a spaghetti micro tube or the connector provided by the manufacturer (for the present study the connector provided by the manufacturer was used; the emitter could be threaded to one end and the micro tube was pushed fit to the other end of the connector).

The single jet adapter type emitter could be connected to a threaded adapter-cum-stake, on to which the 16 mm LDPE lateral could be directly push fit connected.

The double jet type emitters were provided with their own spaghetti micro tube that can be connected to the LDPE lateral using a pin connector. The double jet emitters could be easily distinguished by the special design of the rotor/ spreader.

Test setup- Pump, pipe and control valves

Pressure gauge

Main line, lateral, micro-tube and emitter

Flow rate measurement

Stake assembly

Operational Test-Emitter and catch-cans

Plate 1: Performance evaluation - General experimental setup


ALBL


ALGR


ALRD


JNBK


JNBL


JNGR


JNWH


D-BR


D-LG


D-NG

Plate 2: Emitters - Normal View - Nomanclature

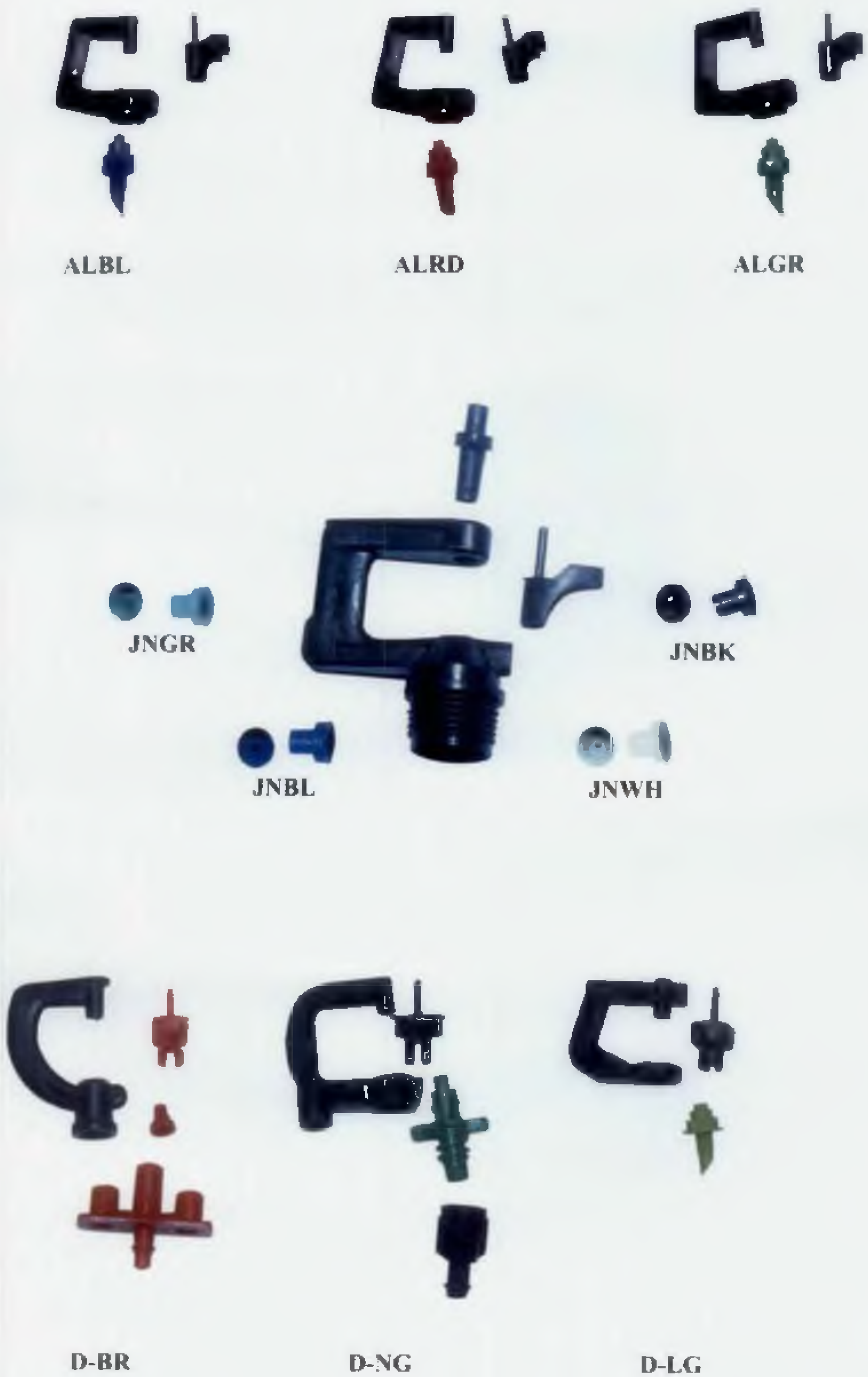


Plate 3: Emitters - Exploded view

3.2. General, Functional and Operational tests

All the tests were conducted as per the standard recommendation of ASAE: S 330.1 - 1991, ASAE: S 398.2 - 1997, BIS: 12232 (part 1, 2) - 1987; suggestions of the draft Indian standard BIS: FAD 54 (590) C - 1997 were also took into consideration (derived from ISO: 8026, 1995).

3.2.1. General tests

All of the emitters were subjected to ocular inspection and strength tests before acceptance.

3.2.1.1. Visual inspection

The emitters were subjected to visual inspection of the individual parts. They were inspected for visible cracks, holes, air bubbles or other defects that may impair the performance and durability of the sprayer, its operation and suitability for installation. The surface smoothness and the ease of change or replacement of parts (e.g. the nozzle) were also observed.

3.2.1.2. Hydrostatic strength test

The emitters were tested to analyse their resistance to hydrostatic pressure. Each of the emitter was connected to the lateral tube; as per the manufacturer's instruction, ensuring no air remains in the system. The water pressure was gradually increased from zero up to 1.2 times the maximum effective pressure (highest working pressure) declared by the manufacturer. The emitter was inspected for leakage or other visible damage during this test.

3.4.1.3. Travelling microscope

The emitters selected were closely examined through a travelling microscope for the exact size and quality of the nozzles. The general shape and smoothness of the nozzle edges were observed to describe the quality of workmanship of the nozzles.

The emitters were selected for the rest of the tests only if they were found satisfactory in the ocular inspection and strength test. Three numbers of each of the ten emitter models of the micro-sprinklers were selected. Based on the nature and quality of the nozzle they were designated as replication R1, R2, and R3.

3.2.2. Functional test

The emitters selected after the visual inspection and strength test were subjected to the functional test for uniformity of flow rate. The testing pressures selected for this were designated as p1, p2, p3, p4 and p5 (p3 being the recommended operating pressure; p2 and p4 being the lowest and highest working pressures declared by the manufacturer and p1 and p5 falling outside the effective operating pressure range recommended by the manufacturer, such that $p1 < p2$ and $p5 > p4$).

As per the instructions of the manufacturer and recommendation of the test standards, the emitter was connected to the LDPE lateral (either directly by means of the adaptor or using a spaghetti micro tube).The emitter connected to the lateral was mounted on a stake assembly and was placed inside a collection vessel. The water pressure of the system was raised to the required testing pressure and a small plastic vessel was placed over the emitter without disturbing the operation, to confine and direct the stream ejected from the emitter to the collection vessel. Plate 1(d) shows the arrangement.

The discharge from the emitter was collected for a specific known period of time and the flow rate of the emitter was calculated as,

$$\text{Flow rate (lph)} = \frac{\text{volume of water collected (ml)/ 1000}}{\text{Time (min)/ 60}}$$

The procedure was repeated for pressure p1, p2, p3, p4 and p5 for replications R1, R2 and R3 of each micro sprinkler model. The functional relationship (pressure Vs discharge relation) of each model was established by plotting the flow rate against the operating pressure.

3.2.3. Operational test

Indoor measurement of single-leg micro-sprinkler patterns were carried out to analyse the distribution performance of the emitter. The technique of catch-can test was considered to be suitable for this purpose.

3.2.3.1. Test Equipment

Catch-cans were placed on 60 cm grid intervals in a matrix extending to a distance of 4.8 m from the emitter, on either side. The emitter was placed exactly at the centre of the matrix. The collectors were 2 litre straight walled cans made of virgin plastic material. The catch-cans were placed at the centre of each square formed by the grid, assuming that each catch-can represents the precipitation rate over that area of 60 cm x 60 cm. The catch-cans were named according to their relative distance and position with respect to the emitter location. The nomenclature of the collectors is shown in Appendix II.

A stake assembly was used to hold the emitter at a height of 20cm above the horizontal plane of the openings of the catch-cans; care was being taken that the stake riser was fixed vertically and did not bend or deviate from that position during the tests. Plate 1(e) shows the stake assembly. The collector at the geometric centre of the matrix of catch-cans surrounded by the adjacent eight collectors was removed and the emitter mounted on the stake was placed there. The Plate 1(f) and Fig. 1 describe the catch-can arrangement and the emitter location.

No evaporation suppressant was used for the present study.

3.2.3.2. Performance testing

Prior to conducting the test, the emitter was operated at the test pressure for some time to wet the surroundings and to ensure trouble free operation. The emitter was then operated for a period of 1 hr while maintaining the test pressure. The emitters were tested at the recommended operating pressure and minimum and maximum effective operating pressures

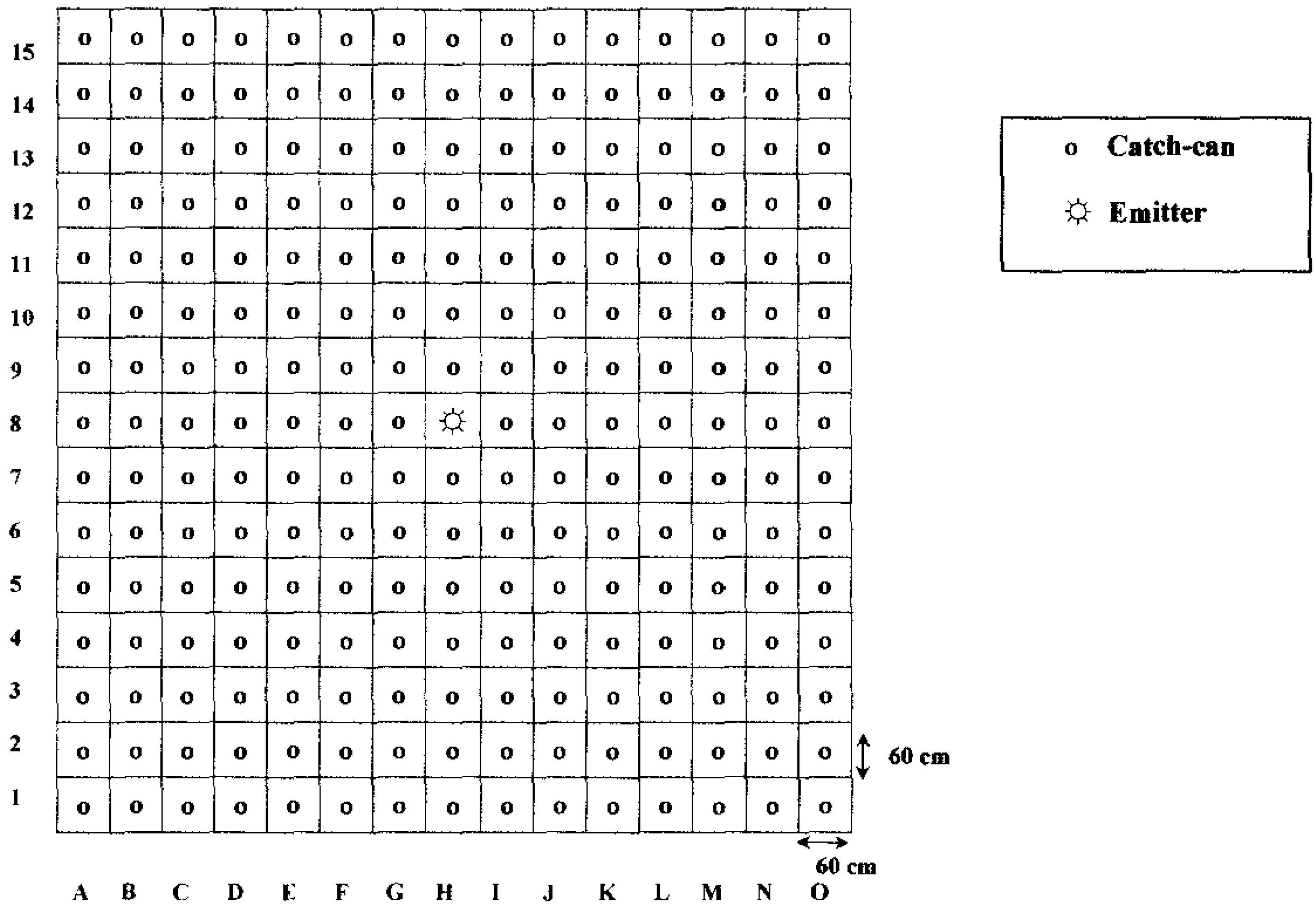


Fig. 1: Placement of catch-cans over the grid

declared by the manufacturers, in three replications. Immediately on conclusion of the test the amount of water collected in each can within the spray coverage area was measured and recorded against the corresponding catch-can location.

3.3. Distribution performance

The catch-can data collected after each test was used to analyse the performance of each micro-sprinkler model. The different factors or indices used to analyse the performance are wetted radius, average application depth, uniformity coefficient, coefficient of variation, distribution characteristic and the distribution patterns.

3.3.1. Determination of wetted radius

As per the standard recommendation, the wetted radius was calculated to be the distance measured from the emitter location to the farthest point at which the emitter deposits water at a minimum rate of 0.26 mm/hr; typically measured at any arc of coverage.

3.3.2. Determination of application depths

The maximum application depth (Dx) was determined as the greatest depth caught in any of the containers for a particular emitter, in cm. The mean application depth (Da) was calculated by averaging the depths of water caught in the cans located within a distance of R from the emitter. The ratio (Dx/Da) was calculated and was represented by 'MAX%' as a percentage. The ratio MAX% being dimensionless was used as a measure for comparison.

3.3.3. Performance indices

The various performance indices used to describe the uniformity of application of the emitters were calculated and the distribution patterns were plotted to get an exact understanding of the water distribution by the emitters.

3.3.3.1. Coefficient of uniformity

The Christiansen's uniformity coefficient was calculated as

$$CUC = 100(1\text{-}da/Da) \quad ; \text{where}$$

'CUC' is the Christiansen's uniformity coefficient (%)

'da' is the average absolute deviation from Da

$$da = \frac{\sum |(di - Da)|}{N} \quad ; \text{where}$$

'di' is the individual application depth

'|(di-Da)|' is the absolute deviation of di from Da

'N', the total number of individual application depths.

3.3.3.2. Coefficient of variation

The coefficient of variation (COV) of the application depths for a particular emitter was calculated by dividing the standard deviation of the application depths by the mean application depth, expressed as a percentage.

$$COV = (SD/Da) \times 100 \; ; \text{where}$$

'SD', is the standard deviation of individual application depths

$$= \frac{\sqrt{\sum (di - Da)^2}}{N}$$

3.3.3.3. Distribution characteristic

'Merriam and Kellers' distribution characteristic (DC) was defined as the ratio of the area; which receives more than half of the average application depth, to the total wetted area, expressed as a percentage. The coefficient was calculated as the ratio of the number of individual application depths greater than half of the mean application depth (i.e. > Da/2) to the total number of the individual application depths.

$$DC = \frac{\text{Area receiving more than half of the mean application depth}}{\text{Total wetted area}}$$

$$= \frac{\text{n, number of individual application depths, greater than Da/2}}{\text{N, total number of individual application depths}}$$

3.3.4. Distribution pattern

The catch-can data was used to plot the 'densograms' corresponding to the spray coverage of the emitters. For a particular test, the amount of water collected in each catch-can was expressed as a percentage of the mean application depth, Da. The computer software 'SURFER' was used to plot the curves by connecting the interpolated points of equal collection (application) rates. The software fills the area between the contour lines; the isograms, connecting points of equal collection rates according to the levels specified. The different levels specified were <10, 10-25, 25-50, 50-100, 100-150, 150-200, 200-300, 300-500, 500-700 and >700 percent of the mean application depth. Thus the contour lines and the filled area together formed the distribution pattern; the densogram, which is most suitable to represent and compare the performance of different micro-sprinklers. The densograms were closely examined to have a critical analysis of the distribution performance of various micro-sprinklers at different applied pressures.

3.4. Comparison Analysis

The different performance indices were used to compare the performance of each micro-sprinkler and to analyse the claim of the manufacturer.

3.4.1. Statistical method

The emitters were categorised in to three groups according to their recommended operating pressures. The emitters ALBL, D-NG and D-BH were in the LOW operating pressure group (1.25 kg/cm^2); emitters ALGR, JNBK, JNBL, JNGR and JNWH were in the MEDIUM operating pressure group (1.5 kg/cm^2); and emitters ALRD and D-LG were in the HIGH operating pressure group (2 kg/cm^2), respectively.

The analysis of various performance parameters (CUC, COV, DC and MAX%) of the emitters were done to evaluate their relative performance, separately for the three groups.

The Kruskal-Wallis test for one way analysis of variance was done to determine whether there was a significant shift in the centres of different parameters used to describe the performance of the emitters. The boxplots of the values of different performance parameters were drawn to get a visual comparison of the performance of the emitters. The software *SYSTAT* (ver 8.0) was used for both the tasks.

3.4.2. Ranking

The method of ranking of different performance parameters was used to compare the individual performance of the emitters at different applied pressures. The final ranking of the total value (sum) of each performance parameter (in three replications) was done to analyse the relative performance of the emitters, among themselves. The emitters were ranked from 1 to 10 according to their performance, based on CUC, COV, DC and MAX%.

3.5. Floppy sprinklers

The floppy sprinkler is one of the newest innovations in the field of sprinkler irrigation technology. The floppy sprinkler has a special type of flexible silicone rubber tube, which becomes instrumental in sprinkling the water. When water is applied under pressure to the device, the water is ejected through the silicon tube to the air, and the pressure difference in and out of the tube causes the tube to vibrate and oscillate in a particular manner such that the water is sprinkled in a circular pattern. The floppy sprinklers operate more or less like a common high pressure sprinkler.

3.5.1. Evaluation of floppy sprinklers

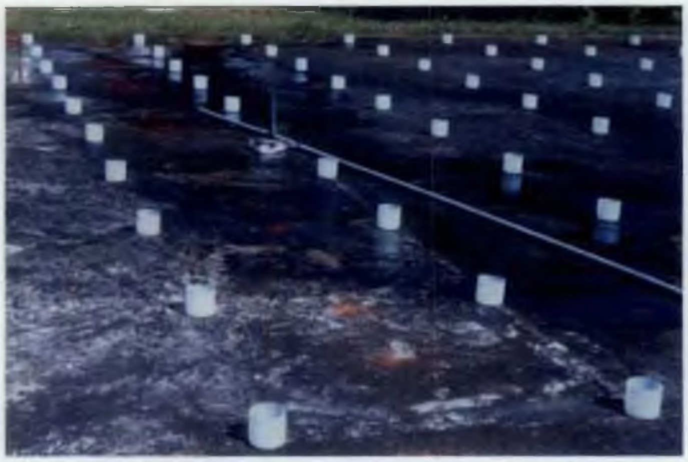
As part of the present study, two models of floppy sprinklers were also evaluated for distribution performance. The sprinklers were designated as JFLP and JFPP. The sprinkler JFPP was a pop-up version of floppy sprinkler, in which the silicone tube is hidden in the emitter body while not in operation. When pressure is applied the tube comes out of the emitter body and operates like a normal sprinkler. The Plate 4(a) shows both types of the devices (note that the silicon tube of the emitter JFPP is pulled out for the sake of taking photographs).

The devices were subjected to catch-can testing and performance parameters were calculated. The procedure adopted for the evaluation of the distribution performance of the floppy sprinklers was similar to that followed for the evaluation of micro-sprinklers. But since the throw radius of the floppy sprinklers were much higher than that of the micro-sprinklers, indoor tests were not possible. The catch-can testing was conducted outdoors, considering the floppy sprinklers to be comparable to common high pressure sprinklers, at the basket-ball court of KCAET, Tavanur (the surface was level with $<1\%$ slope). The average wind speed during the test was measured with sensitive uni-directional anemometer placed just outside the catch-can grid at the same level of the irrigation device. The catch-can grid spacing selected was 150 cm, the emitter being placed at the centre of the of the grid work, surrounded by eight adjoining cans. The Plate 4(b) shows the overall experimental setup.

As per the manufacturers recommendation, the emitter JFLP was operated at a height of 2 m above the plane of the catch-can openings, like common sprinklers (the emitter was connected to a riser tube to raise the emitter to this height) and JFPP was connected directly to the mainline such that the water is sprinkled at a height of about 20 cm above the plane of the catch-can openings. The Plate 4(c) shows the devices JFPP and JFLP .

The operating pressure range specified by the manufacturer for both devices was 2-6 kg/cm^2. The manufacturer has assured constant pressure

Floppy sprinklers - JFPP (Above) and JFLP (Below)



Outdoor performance evaluation of floppy sprinklers

Floppy sprinklers - JFPP connected directly to the main line and JFLP on riser tube

Plate 4: Performance evaluation of floppy sprinklers

compensated performance throughout the specified pressure range. But the emitter JFLP did not work well even at a pressure of 3.5 kg/cm^2, the performance of the emitter did not improve even when the emitter was connected directly to the mainline.

The emitter JFPP was operated at an operating pressure of 3 kg/cm^2 for a period of 1 hr, at the end of the test period the catch-can data was recorded and the performance parameters were calculated.

Results & Discussion

RESULTS AND DISCUSSION

The results of the present study conducted to evaluate the performance of various micro-irrigation devices available in the market were also used to identify the emitters, which showed better performance. This chapter gives a detailed description of the results of the experiments conducted.

4.1. Evaluation for performance

A total of thirty micro-sprinklers (ten different models in three replications) were tested for their individual performance. The emitters were tested to determine their flow rate, water distribution patterns and various performance indices at different operating pressures.

4.2. Acceptance and performance tests

The emitters were subjected to various acceptance tests prior to conducting the performance tests. The acceptance tests included visual inspection, close examination using travelling microscope and hydrostatic pressure strength tests. The performance tests were done to determine the flow rate and the spray distribution characteristics.

4.2.1. Acceptance tests

The emitters selected randomly; from the manufacturer or supplier, were subjected to visual inspection for shortcomings. Some of the samples were found to be defective and they were immediately replaced with other samples of the same make/ model. The emitters were then subjected to the strength test to analyse their resistance to hydrostatic pressure. Only one emitter was found to be having leakage through the gap formed between the threads of the nozzle body and the adapter. The emitter (ALBL) was replaced with another sample of the same model. The nozzles of the emitters were then closely examined through a traveling microscope. The exact size of the nozzles and their general shape and quality are described in Appendix III. The size, shape and smoothness of the nozzle edges are the main factors influencing the functional nature of the emitters.

The emitters chosen after the acceptance tests were selected for further performance testing.

4.2.2. Flow rate

The emitters were tested for the flow rate at different operating pressures. The pressures were selected in such a way that emitters were operated at minimum effective pressure, maximum effective pressure and recommended operating pressure declared by the manufacturer and at pressures below and above the recommended pressure range. The results of the tests are given in Tab. 1 (i, ii). The functional performance of the emitters was determined by analysing the pressure - flow rate relationship established by plotting the flow rate against the operating pressure. Fig. 2(a), (b) and (c) show this relationship of single jet self thread type, single jet adapter type and double jet type of emitter respectively. The curves show a general trend of variation of the flow rate with respect to the operating pressure, which is typical for the sprinkler emitters. The nature of the curve (concave curvature to the axis of operating pressure) satisfies the general relationship of "$q \propto H^{1/2}$". As the nozzle size and operating pressure was increased, a corresponding increase in the flow rate was observed, in all cases. The discharge rate of ALRD was much higher than that of the other emitters in single jet self thread category. The same was observed in case of JNBL and D-LG in their respective categories (this was either due to the larger size of the nozzle or the operation at a higher pressure or a combined effect of both).

Some of the emitters have shown variation in flow rate compared to the data published by the manufacturers. This was obviously due to the variation in the size, shape and quality of the emitter nozzle in contrast to the manufacturers' data. Such observations with large variation were not

Tab. 1(i) : Flow rate of emitters at different applied pressures

Emitter	P (kg/cm^2)	Flow rate (lph)		
		R1	R2	R3
ALBL	0.75	27.000	26.200	20.800
	1.00	31.200	30.600	24.000
	1.25	35.000	33.400	26.800
	1.50	38.200	36.600	29.200
	2.00	44.200	42.400	34.400
ALGR	*0.75*	48.200	52.600	34.800
	1.00	55.600	60.800	40.200
	1.50	68.000	74.200	49.200
	2.00	78.600	85.800	57.000
	2.50	87.800	95.400	63.600
ALRD	*1.00*	125.000	124.400	131.800
	1.50	153.200	152.400	161.400
	2.00	176.800	176.000	186.200
	2.50	197.800	197.200	208.200
	3.00	216.600	215.400	221.800
JNBK	*0.75*	28.200	20.800	27.000
	1.00	32.600	24.200	31.400
	1.50	40.000	29.600	38.200
	2.00	46.200	34.800	44.000
	2.50	51.600	38.000	49.200
JNWH	*0.75*	34.800	40.400	27.200
	1.00	40.200	46.800	31.800
	1.50	49.200	57.200	38.400
	2.00	56.800	66.000	44.400
	2.50	63.600	73.800	49.600
JNGR	*0.75*	43.800	41.200	39.400
	1.00	50.600	47.600	45.400
	1.50	62.000	58.200	55.600
	2.00	71.600	67.200	64.200
	2.50	80.000	75.200	71.800
JNBL	*0.75*	94.800	94.000	99.000
	1.00	109.600	108.400	114.200
	1.50	134.200	132.800	140.000
	2.00	155.000	153.400	161.600
	2.50	173.200	171.600	180.600

Tab. 1(ii) : Flow rate of emitters at different applied pressures

Emitter	P (kg/cm^2)	Flow rate (lph)		
		R1	R2	R3
D-NG	*0.75*	50.400	50.200	50.000
	1.00	58.200	57.600	57.200
	1.25	65.200	64.800	64.400
	1.50	71.400	71.200	69.600
	2.00	82.400	81.200	79.200
D-LG	*1.00*	67.200	67.200	67.200
	1.50	82.400	81.600	82.200
	2.00	95.200	94.200	94.800
	2.50	106.400	105.800	106.200
	3.00	116.600	115.400	116.200
D-BR	*0.75*	97.400	97.400	97.200
	1.00	112.400	111.800	112.200
	1.25	125.600	125.400	125.400
	1.50	137.600	136.800	137.200
	2.00	158.800	155.200	158.000

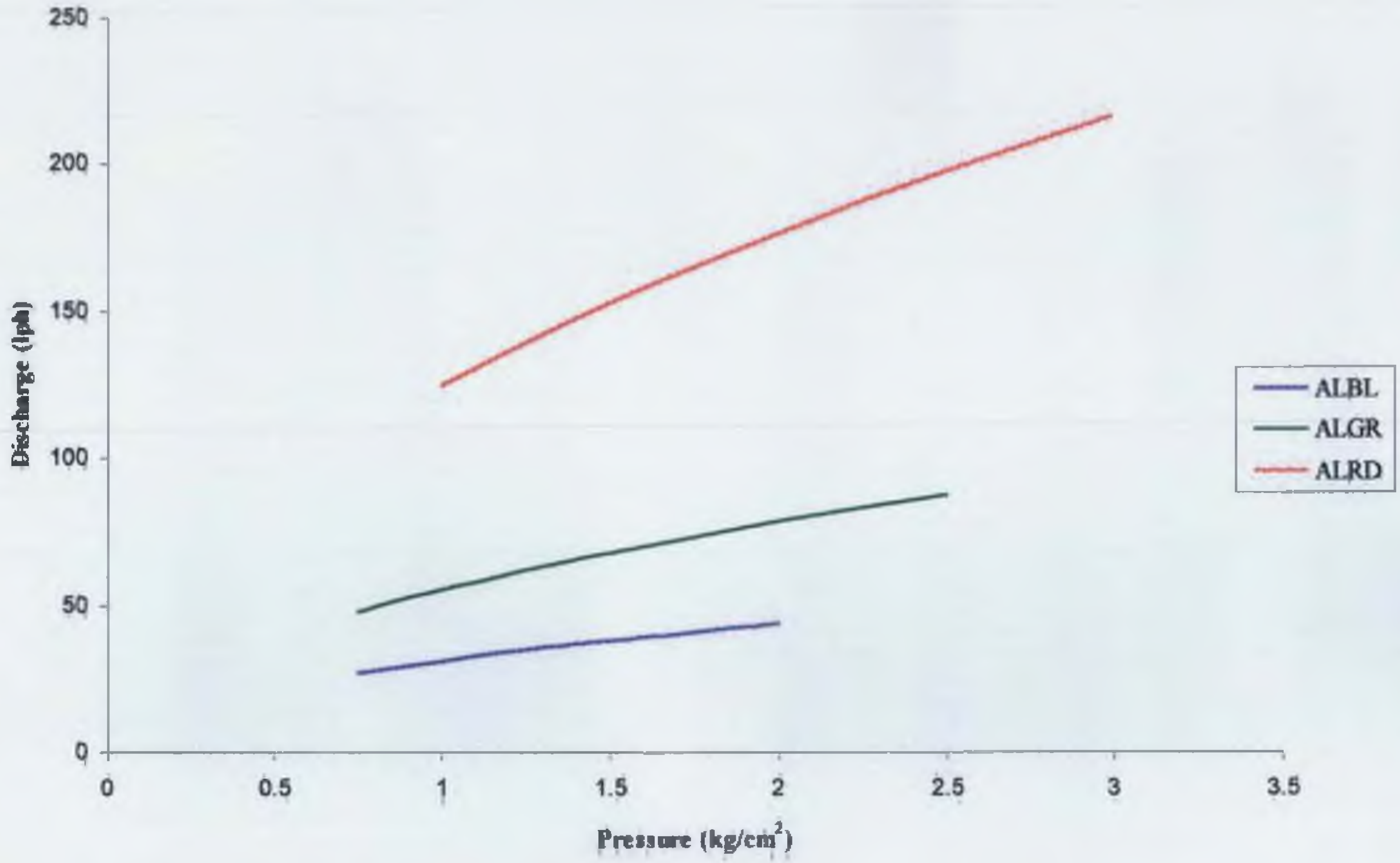


Fig. 2 (a): Pressure-Discharge relationship of single jet, self-thread type emitters

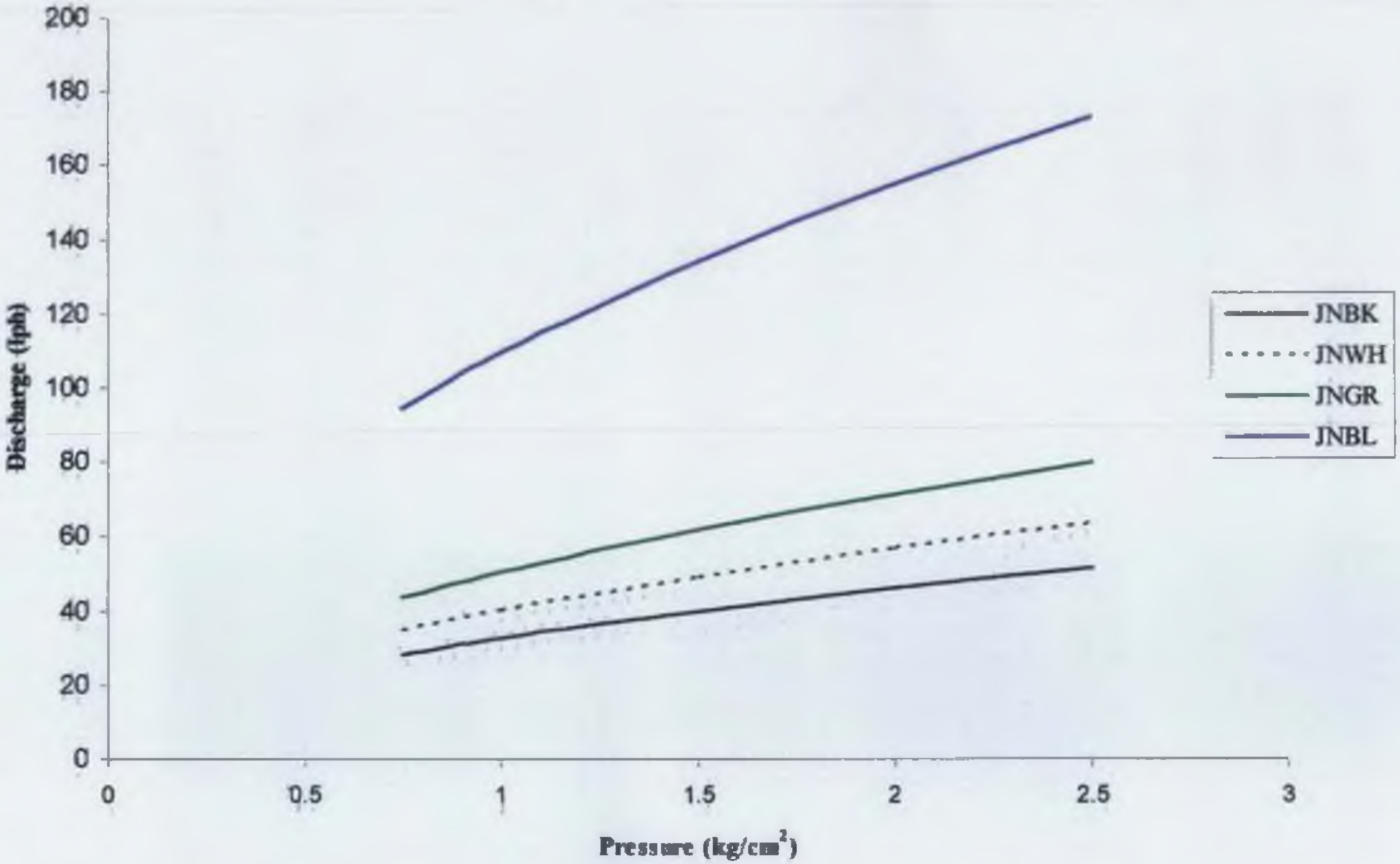


Fig. 2 (b): Pressure-Discharge relationship of single jet, adapter type emitters

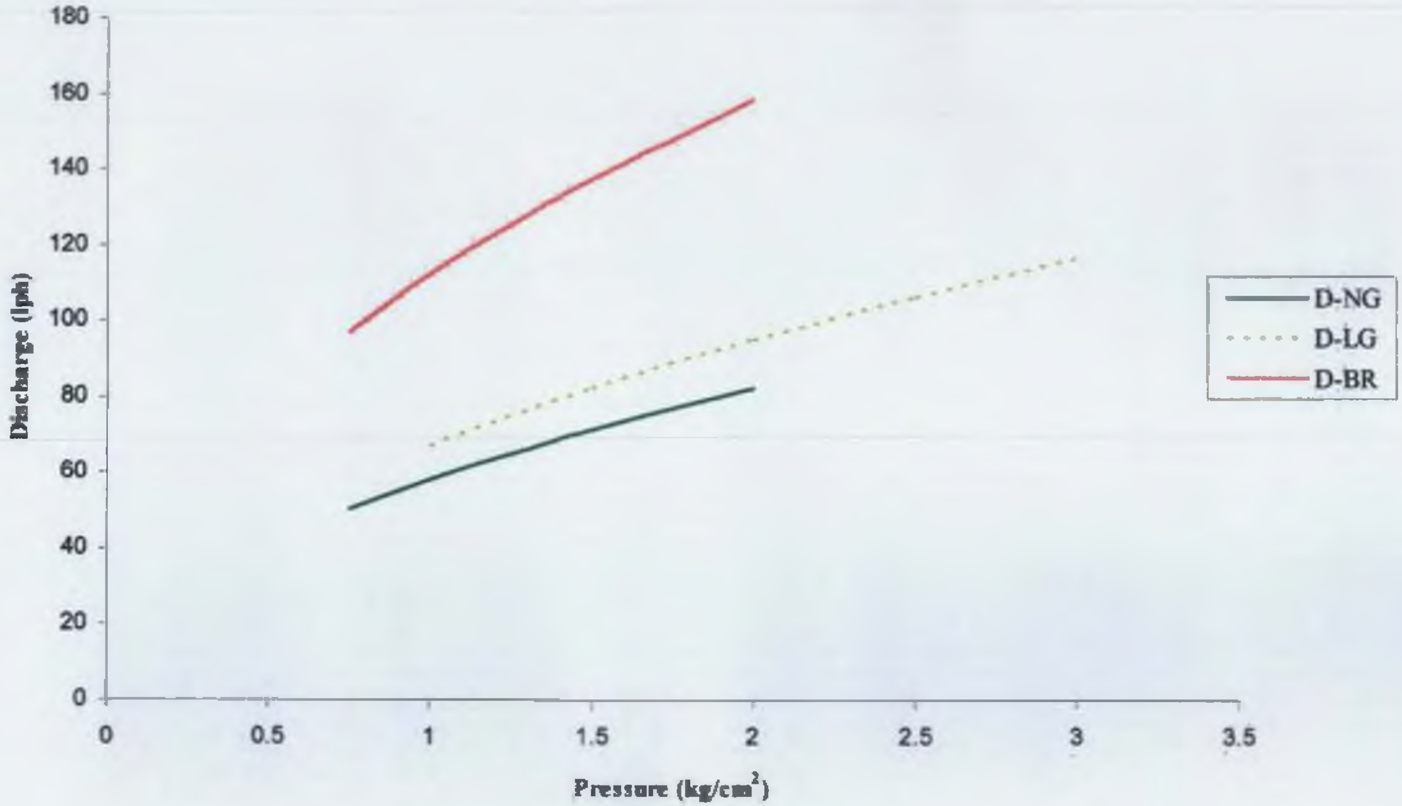


Fig. 2 (c): Pressure-Discharge relationship of double jet type emitters

considered for determining the feasibility of applying a general relationship to the test results.

4.2.3. Distribution performance

The technique of catch-can test was used for the determination of single-emitter micro-sprinkler patterns and their distribution performance. A total of 90 tests were done for ten different micro-sprinkler models at three different operating pressures in three replications. The catch-can data observed in these tests are given in Appendix IV.

4.3. Analysis of distribution performance

The catch-can data was analysed to determine the wetted radius, application depths, different performance parameters and the non-overlapped distribution patterns.

4.3.1. Wetted radius.

The wetted radius was (R) calculated as the distance measured from the emitter location to the farthest point at which the emitter deposits water at a minimum rate of 0.26 mm/hr. All the emitters except D-LG have shown wetted radius equal to or more than 300 cm. The maximum wetted radius was, for emitter JNBL operating at 1.5 and 2.0 kg/cm^2, 485cm. In single jet self thread type, ALRD has the highest R of 365 cm; at 2.5 kg/cm^2. In single jet adapter type JNBL has the highest R, 485 cm at 1.5 kg/cm^2; and for double jet type 457 cm (D-BR operating at 1.5 kg/cm^2). Tab. 2 shows the wetted radius of the emitters at different operating pressures.

4.3.2. Application depth

The maximum application depth (Dx) and mean/ average application depth (Da) were determined for each micro-sprinkler model for different operating pressures (three replications). The highest average application depth

Tab. 2: Radius of coverage of emitters at different applied pressures

Emitter	Pressure (kg/cm^2)	R (cm)		
		R1	R2	R3
ALBL	*1.0*	300	300	300
	1.25	268	300	300
	1.5	255	300	300
ALGR	*1.0*	268	268	268
	1.5	306	306	306
	2.0	306	306	306
ALRD	*1.5*	306	306	306
	2.0	339	339	339
	2.5	365	365	365
JNBK	*1.0*	323	323	323
	1.5	323	323	323
	2.0	350	350	350
JNGR	*1.0*	323	323	323
	1.5	323	323	323
	2.0	360	360	360
JNWH	*1.0*	255	300	300
	1.5	306	306	306
	2.0	306	306	306
JNBL	*1.0*	469	469	469
	1.5	484	484	484
	2.0	484	484	484
D-NG	*1.0*	365	365	365
	1.25	365	365	365
	1.5	384	384	384
D-LG	*1.5*	247	247	247
	2.0	268	268	268
	2.5	268	268	268
D-BR	*1.0*	403	403	403
	1.25	424	424	424
	1.5	457	457	457

Tab. 3(i): Average application depth and MAX%

Emitter	Pressure (kg/cm^2)	R1		R2		R3	
		Da (cm)	MAX%	Da (cm)	MAX%	Da (cm)	MAX%
ALBL	*1.00*	0.131	287	0.146	301	0.130	211
	1.25	0.163	348	0.192	419	0.185	562
	1.50	0.180	324	0.199	407	0.188	554
ALGR	*1.00*	0.173	343	0.171	335	0.140	394
	1.50	0.199	475	0.195	508	0.158	497
	2.00	0.214	655	0.209	622	0.175	570
ALRD	*1.50*	0.401	432	0.404	451	0.405	489
	2.00	0.336	318	0.334	308	0.327	323
	2.50	0.312	390	0.312	379	0.308	395
JNBK	*1.00*	0.138	481	0.129	562	0.126	520
	1.50	0.164	468	0.171	507	0.167	518
	2.00	0.155	509	0.158	568	0.158	583
JNGR	*1.00*	0.140	389	0.144	418	0.141	451
	1.50	0.156	574	0.157	588	0.146	538
	2.00	0.170	468	0.173	535	0.167	507
JNWH	*1.00*	0.177	297	0.180	331	0.157	346
	1.50	0.171	514	0.179	719	0.165	542
	2.00	0.183	536	0.190	487	0.186	476

Tab. 3(ii): Average application depth and MAX%

Emitter	Pressure (kg/cm^2)	Da and MAX%					
		R1		R2		R3	
		Da (cm)	MAX%	Da (cm)	MAX%	Da (cm)	MAX%
JNBL	*1.00*	0.194	497	0.193	500	0.193	489
	1.50	0.206	571	0.209	576	0.209	546
	2.00	0.234	623	0.240	645	0.240	630
D-NG	*1.00*	0.180	207	0.154	222	0.153	223
	1.25	0.142	216	0.140	239	0.135	217
	1.50	0.140	316	0.143	334	0.141	308
D-LG	*1.50*	0.526	691	0.528	808	0.533	603
	2.00	0.514	703	0.529	642	0.535	634
	2.50	0.542	633	0.556	529	0.520	578
D-BR	*1.00*	0.159	427	0.158	395	0.157	374
	1.25	0.162	584	0.160	619	0.158	568
	1.50	0.169	476	0.172	505	0.171	478

was 0.556 cm, shown by emitter D-LG at 2.5 kg/cm^2 and the lowest average application depth was 0.126 cm, shown by emitter JNBK at 1.0 kg/cm^2. Tab. 3 shows application depth and MAX% observed in the tests.

4.3.3. Performance parameters

Since the micro-irrigation emitters available in the market are different in many aspects, it becomes necessary to use some dimensionless parameters to compare their performance. The uniformity coefficient, the coefficient of variation and the distribution characteristic are the indices calculated, to compare the performance of the devices evaluated in this study. They offered a way to easily weigh the performance of the emitters against each other.

4.3.3.1. Uniformity Coefficient

The Christiansen's Uniformity Coefficient directly gives a measure of the uniformity or non-uniformity of distribution of micro-sprinklers. The highest and lowest values of CUC shown by single jet self thread type emitters were 49% (ALBL at 1.0 kg/cm^2) and 20% (ALGR at 2.0 kg/cm^2); for single jet adapter type emitter the values were 38% (JNBL at 1.0 kg/cm^2) and 11% (JNBK at 1.0 kg/cm^2) and for double jet type emitters 55% (D-NG at 1.25 kg/cm^2 and 1.5 kg/cm^2) and 7.3% (D-LG 1.5 kg/cm^2) respectively. Tab. 4 shows the values of CUC shown by the emitters at different pressures.

4.3.3.2. Coefficient of Variation

Tab. 5 shows the values of coefficient of variation of catch-can observation data of the tests conducted. Since the coefficient of variation is the measure of the deviation of individual observation from the mean higher values of COV represent a poor distribution (large deviation from the average application depth) and lower values represent better performance. A COV value of an emitter which is less than 100% indicates "good" performance by that emitter.

Tab. 4: Christiansen Uniformity Coefficient, CUC

Emitter	Pressure (kg/cm^2)	CUC (%)		
		R1	R2	R3
ALBL	*1.00*	49.2	42.7	38.0
	1.25	33.9	28.1	24.3
	1.50	38.7	29.5	26.0
ALGR	*1.00*	36.4	38.4	38.0
	1.50	29.3	28.2	29.6
	2.00	27.2	24.3	20.4
ALRD	*1.50*	46.7	47.3	46.8
	2.00	43.8	42.7	40.3
	2.50	33.6	34.2	33.4
JNBK	*1.00*	19.9	17.2	10.7
	1.50	25.9	21.7	16.5
	2.00	21.9	22.2	18.3
JNGR	*1.00*	32.6	31.4	27.3
	1.50	23.6	23.2	22.9
	2.00	24.1	21.5	21.2
JNWH	*1.00*	33.6	28.7	29.8
	1.50	24.8	24.7	26.8
	2.00	22.7	20.6	22.0
JNBL	*1.00*	38.0	36.3	37.4
	1.50	24.2	20.1	22.6
	2.00	20.3	18.2	19.9
D-NG	*1.00*	50.8	49.1	49.2
	1.25	54.9	54.5	38.3
	1.50	41.3	39.3	55.1
D-LG	*1.50*	7.54	7.78	7.27
	2.00	12.2	10.2	11.5
	2.50	17.6	14.5	17.5
D-BR	*1.00*	37.7	36.7	36.6
	1.25	39.2	37.2	37.2
	1.50	32.5	31.6	30.5

Tab. 5: Coefficient of Variation, COV

Emitter	Pressure (kg/cm^2)	COV (%)		
		R1	R2	R3
ALBL	*1.00*	65.7	73.2	87.3
	1.25	84.5	93.6	107.5
	1.50	79.7	99.6	112.8
ALGR	*1.00*	81.4	78.3	80.8
	1.50	94.2	99.1	100.1
	2.00	107.6	102.0	113.5
ALRD	*1.50*	74.7	75.2	77.7
	2.00	75.6	75.7	77.3
	2.50	89.0	88.2	88.7
JNBK	*1.00*	106.0	117.6	124.7
	1.50	98.9	105.8	113.3
	2.00	104.1	106.3	109.9
JNGR	*1.00*	93.7	97.2	102.2
	1.50	108.9	111.0	108.8
	2.00	101.9	107.6	106.5
JNWH	*1.00*	80.0	88.0	87.8
	1.50	101.7	114.6	101.7
	2.00	109.1	108.1	107.3
JNBL	*1.00*	90.5	93.9	92.7
	1.50	108.6	113.0	109.9
	2.00	109.3	111.6	109.4
D-NG	*1.00*	56.5	58.0	57.5
	1.25	54.5	55.3	53.4
	1.50	72.6	74.3	74.8
D-LG	*1.50*	150.0	160.4	141.9
	2.00	128.9	129.1	122.9
	2.50	119.6	116.2	113.2
D-BR	*1.00*	81.6	82.1	81.8
	1.25	83.0	87.4	86.2
	1.50	87.8	90.0	93.2

Based on the COV values the best performance observed was by emitter D-NG (53% at1.25 kg/cm^2). The highest and lowest values of COV (poor and good performance) shown by single jet self thread type emitters were 114% (ALGR at 2.0 kg/cm^2) and 66% (ALBL at 1.0 kg/cm^2), single jet adapter type emitters were 125% (JNBK at 1.0 kg/cm^2) and 80% (JNWH at 1.0 kg/cm^2) and by double jet type emitters were 160% (D-LG at 1.5 kg/cm^2) and 53% (D-NG at 1.25 kg/cm^2)

4.3.3.3. Distribution Characteristic

Merriam and Keller's distribution characteristic shows the percentile area receiving irrigation water at a rate, higher than half of the average application rate over the total irrigated area. It was calculated as the ratio of the number of catch-cans that received more than half of the average application depth, to the total number of catch-cans placed over the wetted area. The best performance shown by an individual emitter (D-NG) in the present study was a DC of 79.5%. This shows that about 80% of the total wetted area receives more than half of the average application depth. The good and poor performance shown by single jet self thread type emitters were 76% (ALRD at 1.5 kg/cm^2) and 51% (ALGR at 2.0 kg/cm^2), 72% (JNBL at 1.0 kg/cm^2) and 44% (JNBK at 1.0 kg/cm^2) by single jet adapter type emitters and 80% (D-NG at 1.25 kg/cm^2) and 47.6% (D-LG at 1.5 kg/cm^2) by double jet type emitters. Tab. 6 shows the values of DC.

4.3.4. Distribution Pattern

The densograms plotted, by joining the points of equal application rate and shading the space between those isograms corresponding to the percentile proportion of the corresponding application rate, (compared to Da) were analysed. The densograms gave a good visual impression of the nature of water distribution under different emitters. The isograms were seen to curve to the direction of the emitter (to the centre) from the left side of the figures.

Tab. 6: Distribution Characteristic, DC

Emitter	Pressure (kg/cm^2)	DC (%)		
		R1	R2	R3
ALBL	*1.0*	73.1	67.3	67.3
	1.25	63.6	59.6	61.5
	1.5	62.8	59.6	55.8
ALGR	*1.0*	64.8	66.7	61.1
	1.5	56.3	57.8	59.4
	2.0	58.0	56.5	50.7
ALRD	*1.5*	75.7	71.4	70.0
	2.0	69.9	68.8	66.7
	2.5	66.1	65.1	59.6
JNBK	*1.0*	55.6	49.1	43.9
	1.5	62.1	59.3	54.2
	2.0	55.4	52.2	50.0
JNGR	*1.0*	62.8	64.7	62.9
	1.5	56.1	59.6	56.9
	2.0	57.7	54.7	56.6
JNWH	*1.0*	67.3	59.3	62.5
	1.5	59.2	57.5	57.5
	2.0	52.9	50.7	51.5
JNBL	*1.0*	72.1	65.6	70.5
	1.5	58.5	53.1	55.8
	2.0	55.6	52.5	51.9
D-NG	*1.0*	69.9	70.9	68.9
	1.25	77.5	77.7	79.5
	1.5	67.8	68.6	66.1
D-LG	*1.5*	52.4	50.0	47.6
	2.0	51.2	48.8	48.8
	2.5	53.5	51.2	53.5
D-BR	*1.0*	75.2	72.0	67.2
	1.25	75.4	73.3	72.6
	1.5	65.8	61.0	60.3

This is obviously due to the low application depths in those regions caused by the shading effect of the frame/ arm of the emitter, directed towards the grid point A8 (0,450).

4.3.4.1. ALBL

The Fig. 3(a), (b) and (c) show the densograms of emitter ALBL at 1.0, 1.25 and 1.5 kg/cm^2 respectively. The densograms show a gradual increase in the application rate from the outer perimeter to the centre (location of the emitter). The entire distribution pattern and the isograms are almost circular, although the central part of the figures shows some skewed patterns. In all three cases, a large portion at the centre of the pattern is representing application depth greater than 50% Da, thus having higher values of DC. While operating at 1.25 kg/cm^2 the emitter produces application depths more than 3 times Da, shown by the darker area at the centre.

4.3.4.2. ALGR

The Fig. 4(a), (b) and (c) show the densograms of emitter ALGR at 1.0, 1.5 and 2.0 kg/cm^2. All the three figures show clear indication of poor performance by ALGR emitter. Although there is a constant increase in application depth up to 150% Da, the distinct zones of higher application depth at the central part of the wetted area shows high non-uniformity of application. The emitter even produces application depths more than 6 times Da at 2.0 kg/cm^2. Although the DC values are high, the densograms justifies the low values of CUC and high values of COV (eg. COV, 108 at 2 kg/cm^2); indicating low uniformity.

4.3.4.3. ALRD

The Fig. 5(a), (b) and (c) show the densograms of ALRD at 1.5, 2.0 and 2.5 kg/cm^2. As expected the wetted area is more in case of the ALRD emitter (compared to other emitter in the single jet self thread emitter), in response to

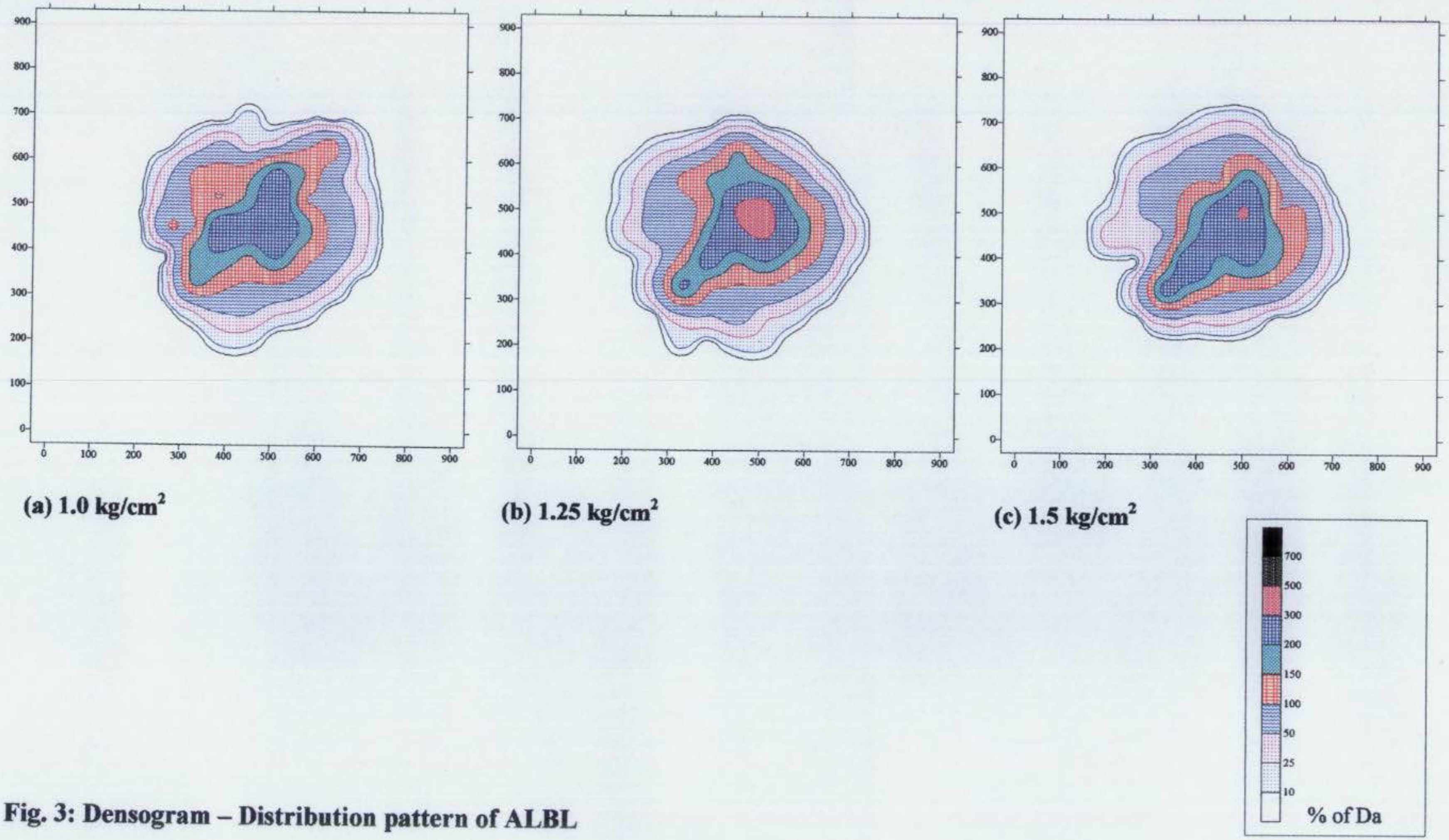
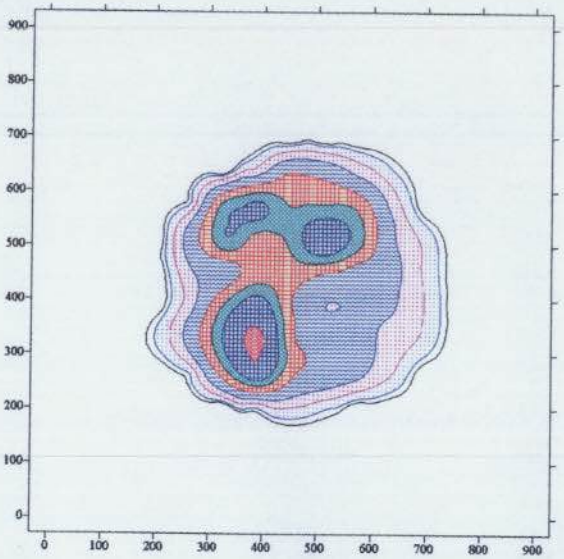
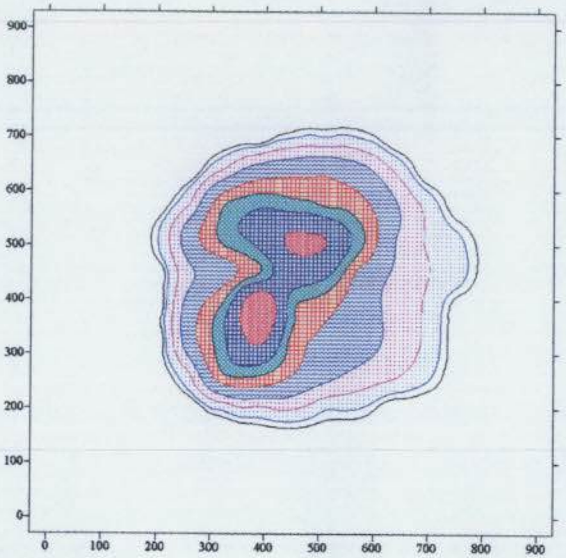


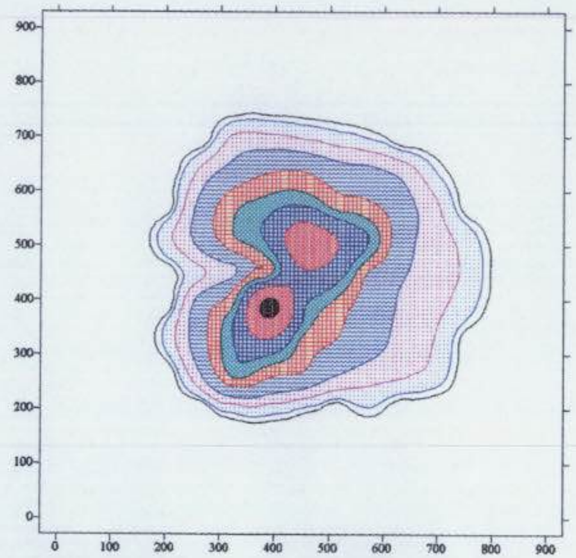
Fig. 3: Densogram – Distribution pattern of ALBL



(a) 1.0 kg/cm^2



(b) 1.5 kg/cm^2



(c) 2.0 kg/cm^2

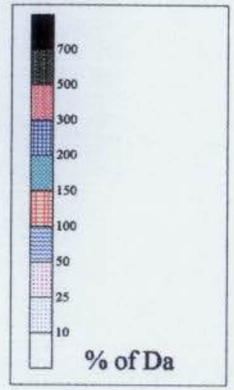
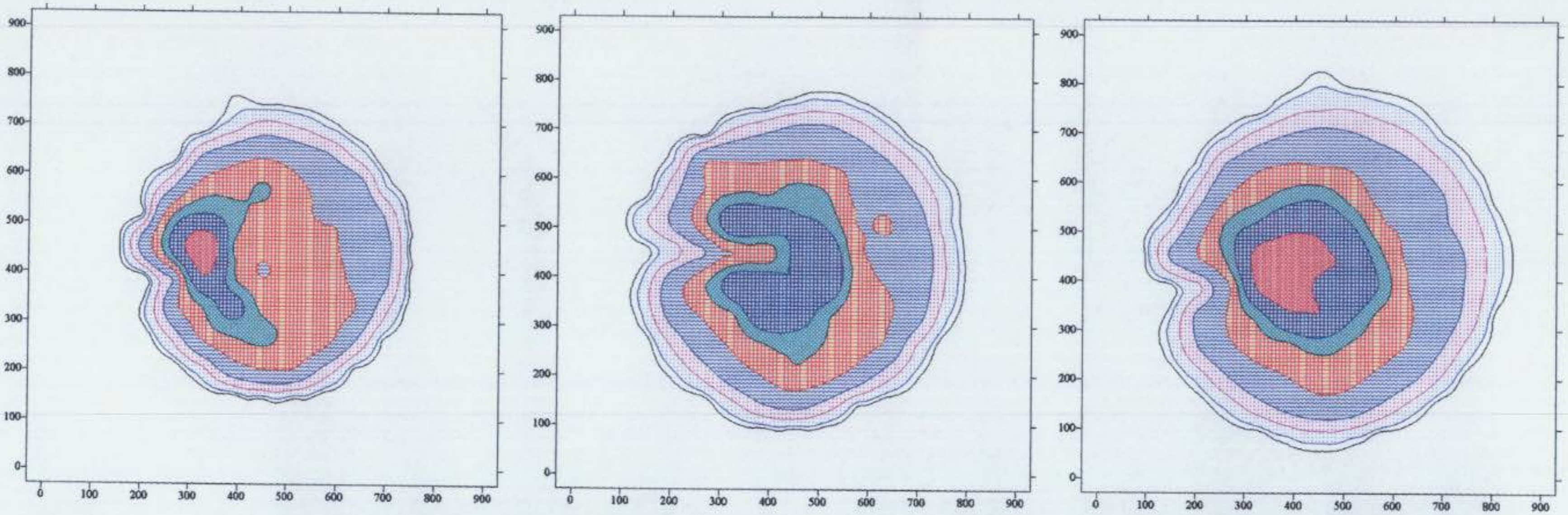


Fig. 4: Densogram – Distribution pattern of ALGR



(a) 1.5 kg/cm^2 (b) 2.0 kg/cm^2 (c) 2.5 kg/cm^2

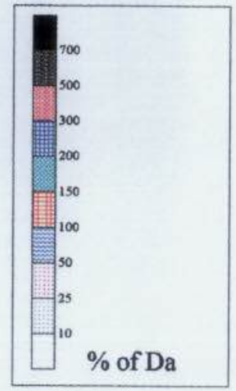


Fig. 5: Densogram – Distribution pattern of ALRD

the higher operating pressures. A constant increase in the application depth towards the centre is observed although there is a skewed pattern of higher application at 1.5 kg/cm^2, creating a visual effect of a doughnut development. This effect is not clear at 2.5 kg/cm^2.

Although the DC value is high, the presence of a considerable area with application depth more than 3 times Da at 2.5 kg/cm^2 reduces the uniformity (low values of CUC and high value of COV).

4.3.4.4. JNBK

The JNBK is another emitter that shows very poor distribution performance. The densograms of this emitter are shown in Fig. 6(a), (b) and (c) corresponding to operating pressure 1.0, 1.5 and 2.0 kg/cm^2 respectively. The distribution patterns are of irregular rectangular shape rather than the general circular pattern.

The shading effect of the emitter frame is noticeable in all three cases, and the uneven placement of the high and low application depths results in patterns of very complex nature. Most part of the distribution patterns correspond to application depths < 50% Da; the patterns include considerable areas of higher application depths (> 300% Da) also, thus the densograms comply with the performance parameters indicating poor performance.

4.3.4.5. JNGR

The Fig. 7(a), (b) and (c) represents the distribution patterns of JNGR operating at 1.0, 1.5 and 2.0 kg/cm^2. The 'irregular kite' shaped densograms (the shading effect of the emitter frame on both sides) justifies the indication of the performance parameters. Although more than half of the pattern area corresponds to application depths > 50% Da, the presence of significant area of high application depths result in poor performance by the emitter (the densogram at 1.5 kg/cm^2 includes a region of application depth > 500% Da, represented by a small circular area adjacent to the emitter location).

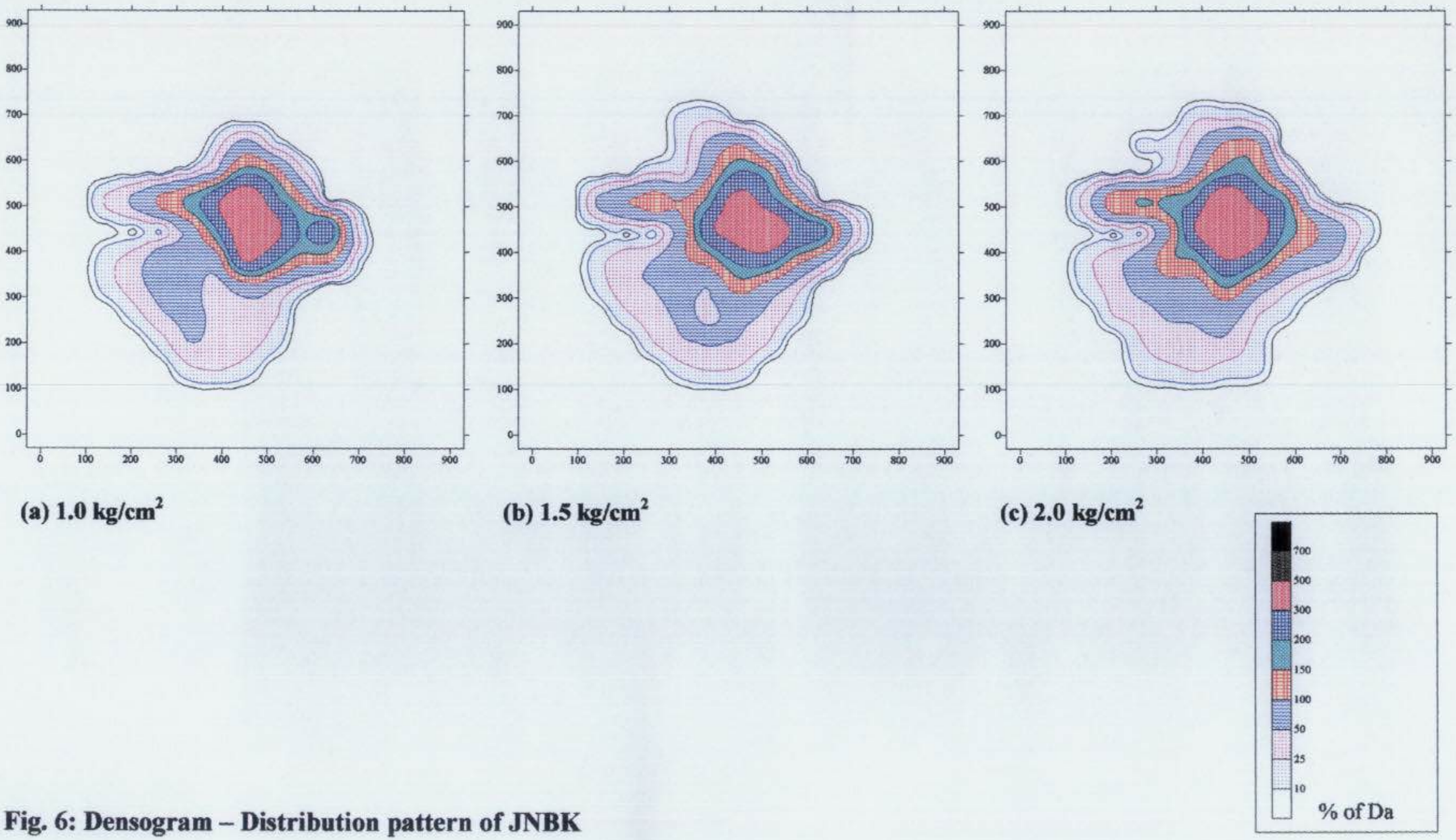


Fig. 6: Densogram – Distribution pattern of JNBK

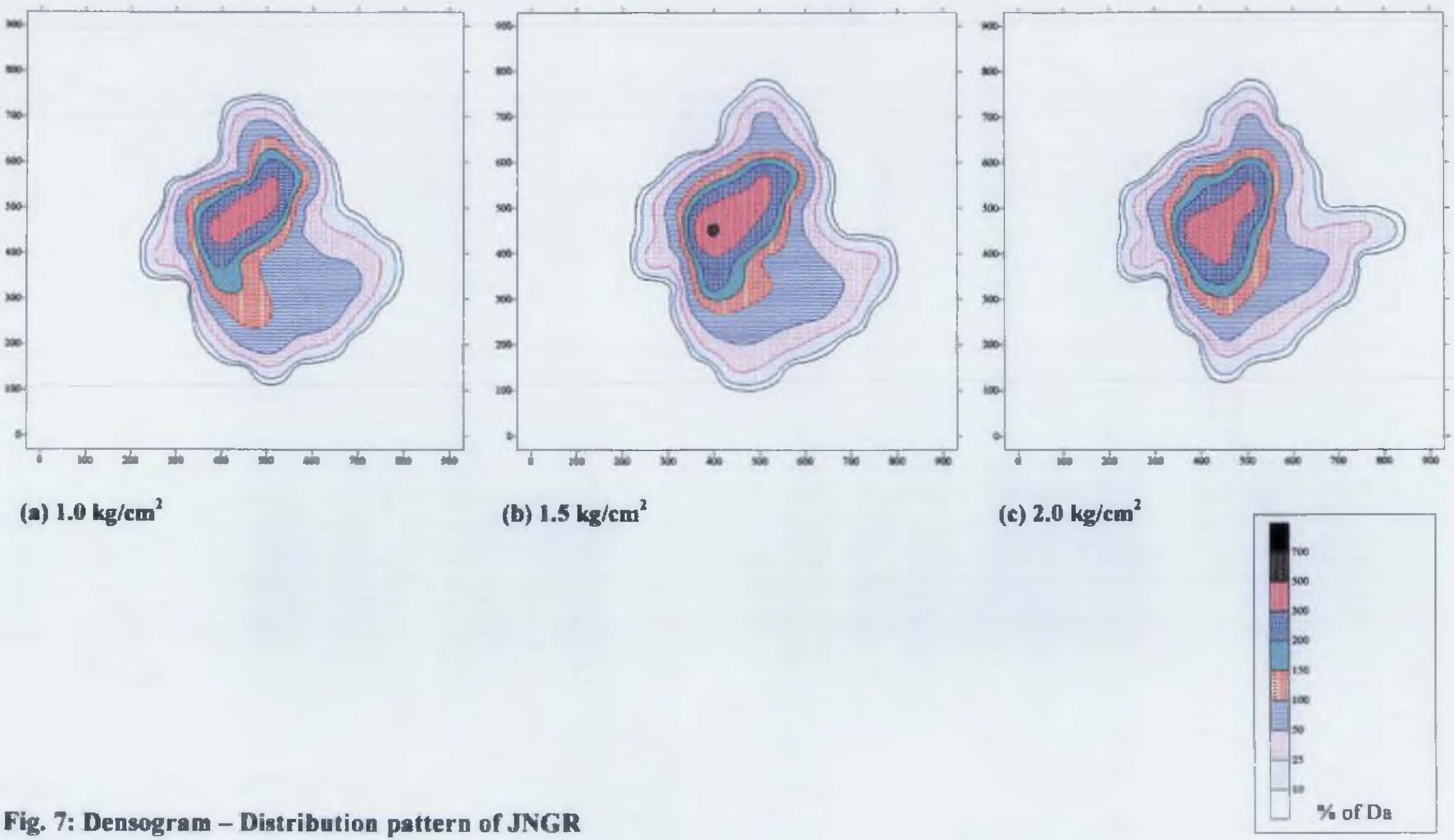


Fig. 7: Densogram – Distribution pattern of JNGR

4.3.4.6. JNWH

The JNWH is the only emitter that showed a general circular wetting pattern among the single jet adapter type emitters. The Fig. 8(a), (b) and (c) show the densograms corresponding to operation at 1.0, 1.5 and 2.0 kg/cm^2. Although the performance parameters indicate comparable good performance at 1.0 kg/cm^2, as the pressure is increased the performance is diminished as a result of the increased pattern area and presence of high application depths.

The densogram at 1.0 kg/cm^2 shows even placement of water and gradual increase in application depth; the maximum application depth being less than 300% Da, while considerable portion of the pattern corresponds to application depths even more than 500% Da at higher operating pressures.

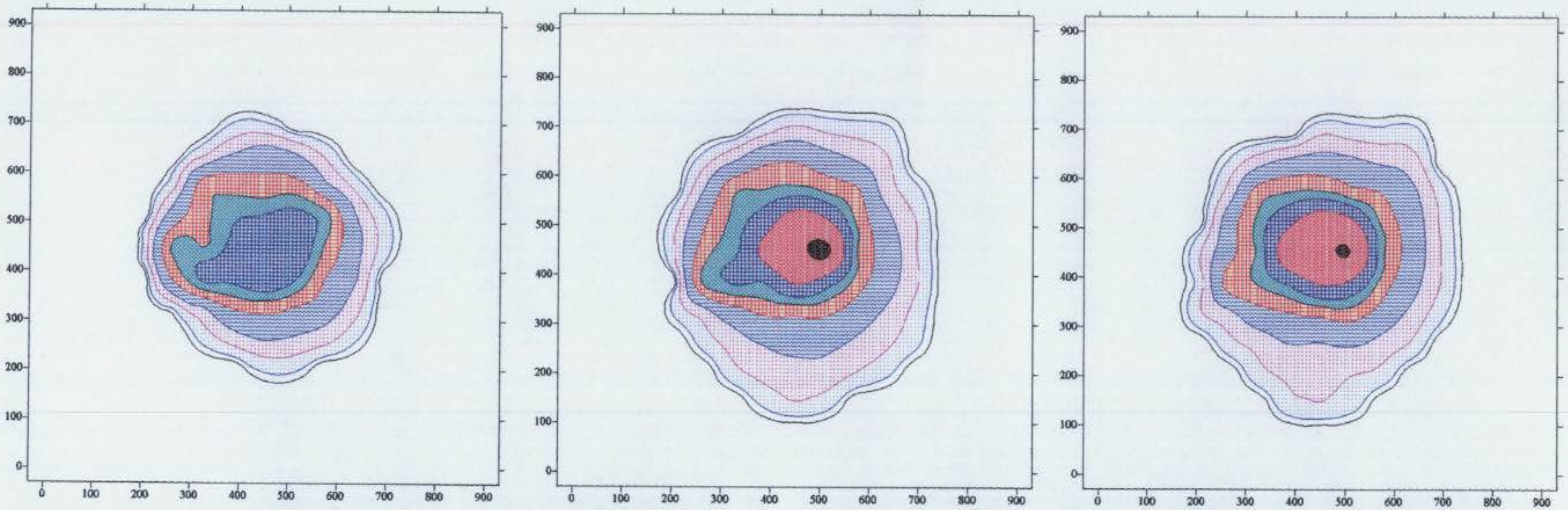
4.3.4.7. JNBL

The densograms of the emitter JNBL shown in Fig. 9(a), (b) and (c) corresponding to 1.0, 1.5 and 2.0 kg/cm^2 gives an impression of better performance; the coverage area is more compared to other emitters in single jet adapter type emitters. The shading effect of the emitter frame is present at all the three operating pressures. The application depths corresponding to most parts of the wetted area are more than 50% Da in all three cases.

As the operating pressure is increased the radius of throw is also increased; the increased wetted area results in a corresponding decrease in the DC value. At higher operating pressures the application depth at the centre of the patterns increases from 300% Da to depths > 500% Da (at 2.0 kg/cm^2 the emitter produces application depths even > 600% Da) Corresponding changes in COV and CUC are also observed indicating reduced performance.

4.3.4.8. D-NG

The Fig. 10(a), (b) and (c) show the distribution performance of D-NG emitter, at 1.0, 1.25 and 1.5 kg/cm^2 respectively. The patterns are of good circular shape and good performance of the emitter (as indicated by the



(a) 1.0 kg/cm^2 (b) 1.5 kg/cm^2 (c) 2.0 kg/cm^2

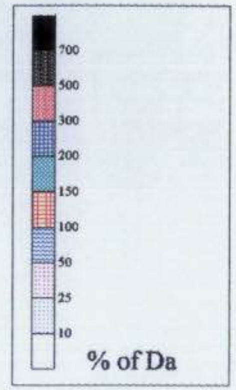
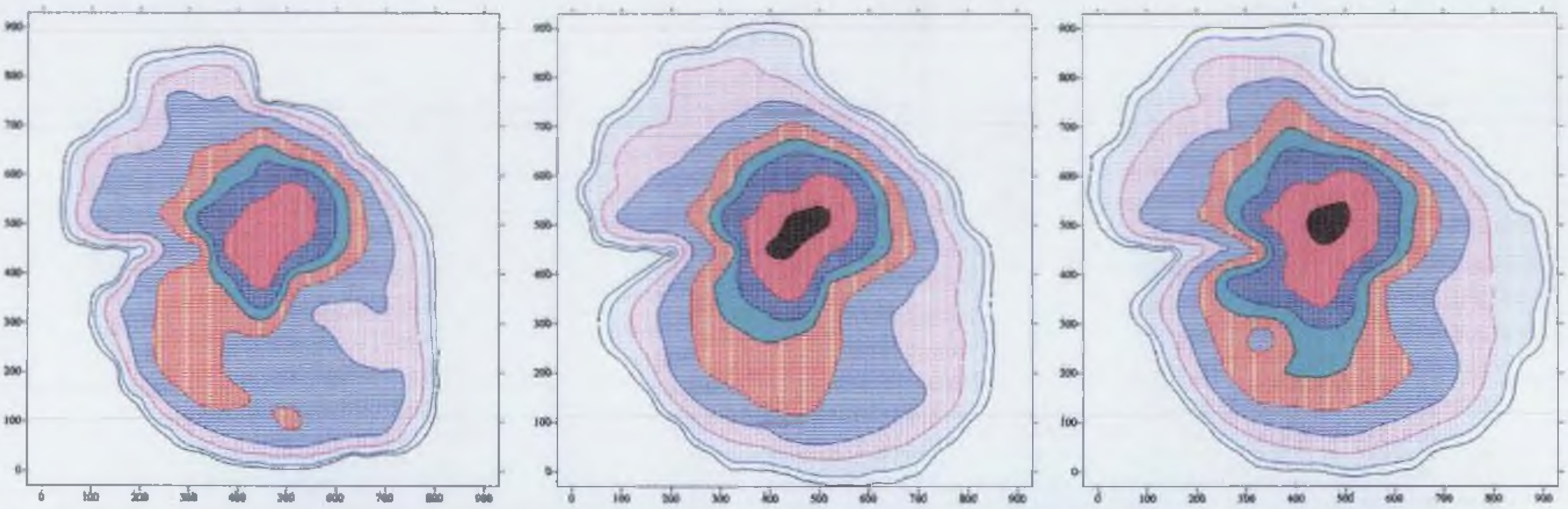


Fig. 8: Densogram – Distribution pattern of JNWH



(a) 1.0 kg/cm^2 (b) 1.5 kg/cm^2 (c) 2.0 kg/cm^2

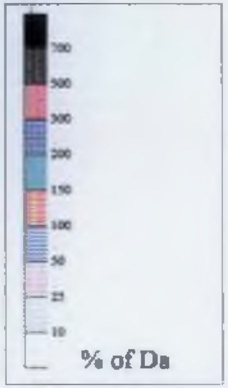
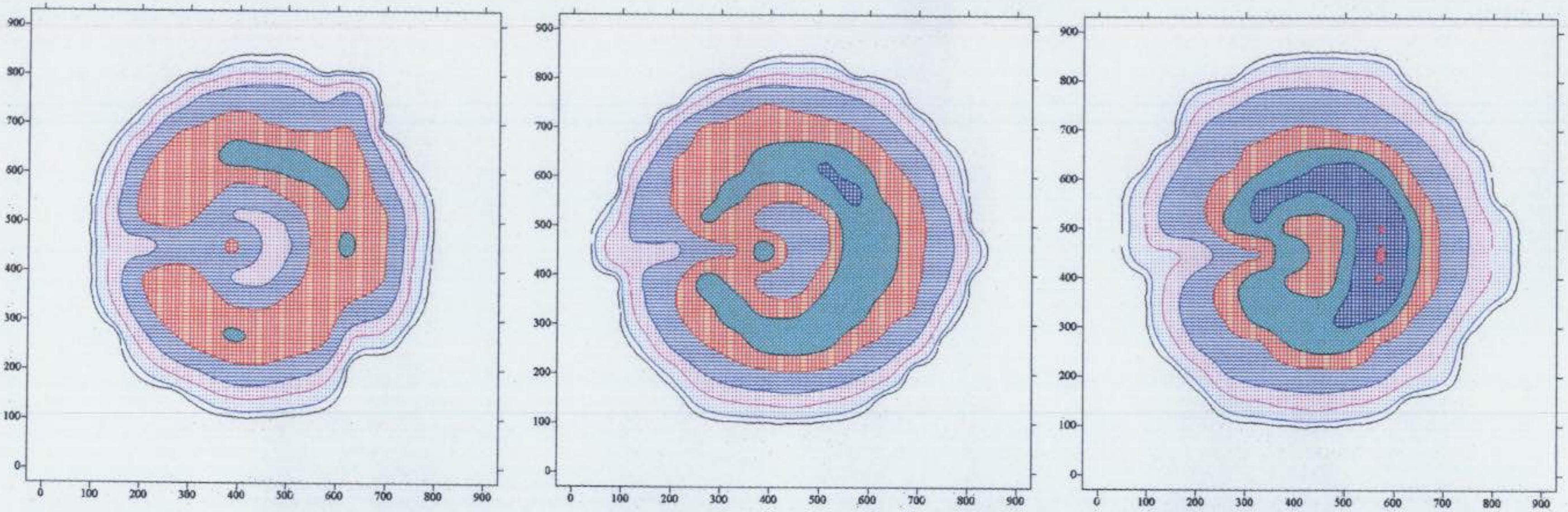


Fig. 9: Densogram – Distribution pattern of JNBL



(a) **1.0 kg/cm^2**

(b) **1.25 kg/cm^2**

(c) **1.5 kg/cm^2**

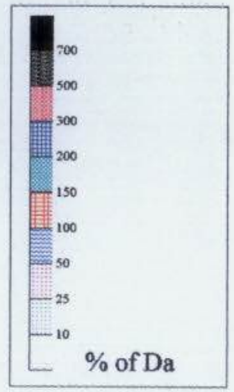


Fig. 10: Densogram – Distribution pattern of D-NG

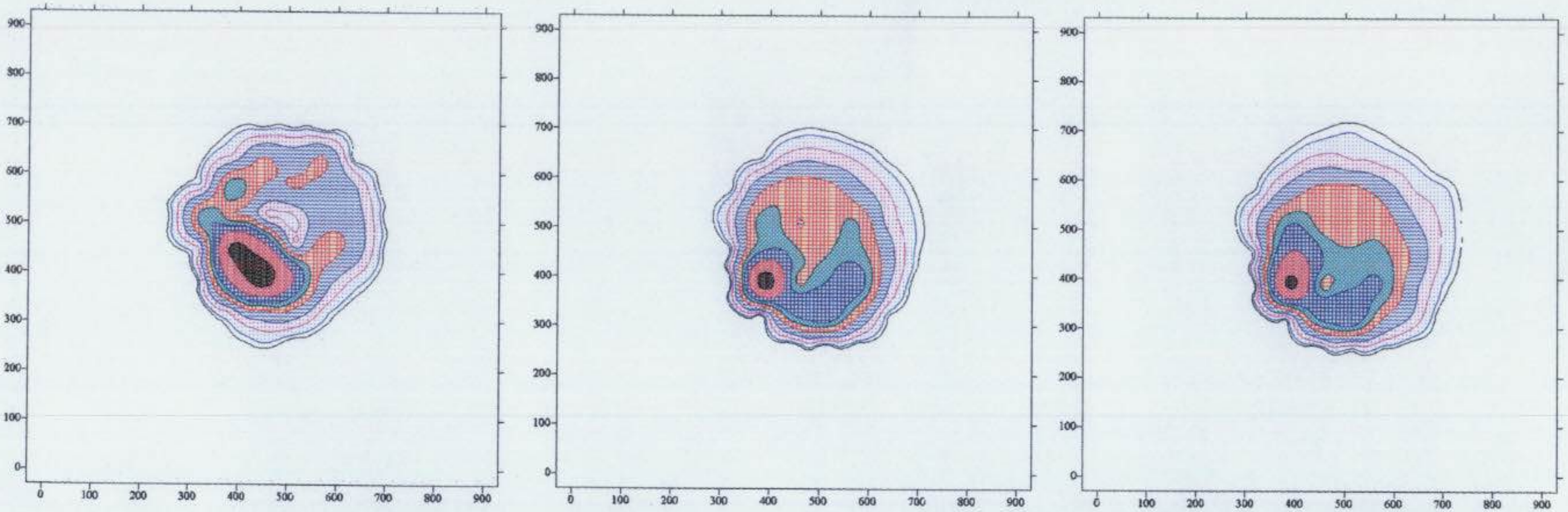
performance parameters) may be inferred from the densograms also. A comparably larger area having application depth more than 50% Da and good distribution of high and low amounts of application depths (only a small part of the wetted area corresponds to application depth more than 2 times Da) justifies the performance indicators of the emitter. But all the three densograms clearly show uneven placement of water within the wetted area. The water application depth is more to the right and top sides compared to left and bottom sides of the densograms, due to the distinct incomplete circular patterns of high application depth.

As the operating pressure is increased from 1.0 to 1.5 kg/cm^2, the performance indicators show a general trend of reduced performance. But by closely analysing the densograms it is evident that the placement of the applied water depths is becoming more even as the pressure is increased. It may be concluded that the emitter may perform better if the operating pressure range is modified. The emitter should be tested at higher operating pressures to confirm this possibility.

4.3.4.9. D-LG

The distribution performance of the emitter D-LG is represented by Fig. 11(a), (b) and (c) at 1.5, 2.0 and 2.5 kg/cm^2 respectively. The poor performance by the emitter is clearly visible from the densograms. At all the three operating pressures, the entire distribution pattern is skewed to the opposite side of the frame/ arm of the emitter; thus leaving the most part of the area intended to irrigate (the circular area of radius equal to the radius of throw, R) un-irrigated.

The distribution pattern is formed by irregular shaped, distinct areas of very high and low application depths. The application depth corresponding to the area adjacent to the emitter location is very high compared to the average application depth (about 700% Da). By analysing the densograms it can be generally stated that the performance of the emitter is improved when



(a) 1.5 kg/cm^2

(b) 2.0 kg/cm^2

(c) 2.5 kg/cm^2

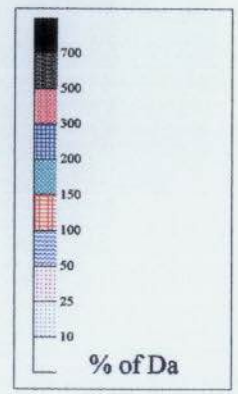


Fig. 11: Densogram – Distribution pattern of D-LG

the operating pressure is increased (the doughnut patterns disappeared and the whole pattern became more evenly and circularly distributed). The operation of this emitter may become beneficial or improved from the manufacturer's point of view, but the performance of the emitter in the present condition is not acceptable from the farmers' point of view.

4.3.4.10. D-BR

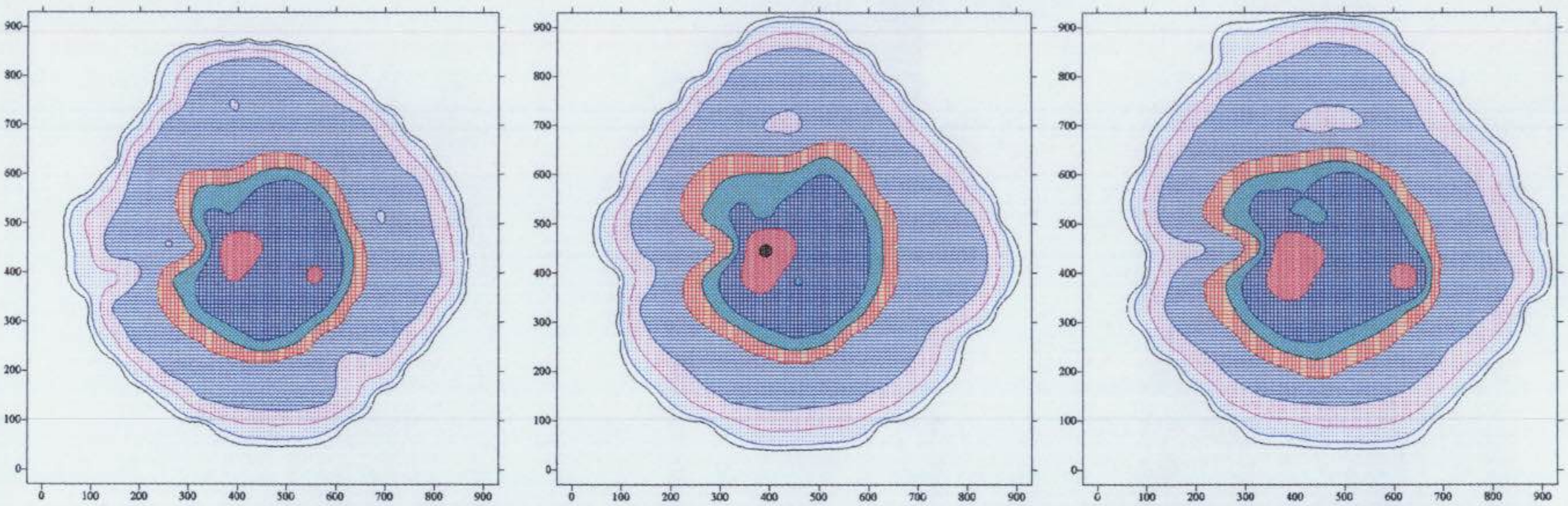
The densograms of the emitter D-BR are shown in Fig. 12(a), (b) and (c) corresponding to operation at 1.0, 1.25 and 1.5 kg/cm^2 respectively. A comparable good performance of the emitter is evident as indicated by the regular increase in application depth towards the centre and a larger area of an application depth > 50% Da. The densograms have a rectangular shape with curved corners. In all the densograms wetted area corresponding to the level 50 - 100 % Da was more compared to other emitters. The shading effect of the emitter frame was apparent in all the three operating pressures. There were distinct zone of higher application depths (> 3 times Da) at the central portion of the densograms. As the pressure was increased from 1 to 1.5 kg/cm^2, gradual development of a zone of low application was observed, at the top of the densogram. At 1.25 and 1.5 kg/cm^2, the emitter puts water to the farthest catch-cans placed at the extreme top and right sides of the grid.

4.4. Comparison of the performance

The values of different performance parameters calculated were used to compare the performance of the emitters. The comparison was done by different statistical and ranking tools.

4.4.1. Comparison by statistical methods

The statistical methods used include the analysis of variance and boxplots. The Kruskal-Wallis one way analysis of variance of the different performance parameters were done to investigate whether the mean of the



(a) 1.0 kg/cm^2

(b) 1.25 kg/cm^2

(c) 1.5 kg/cm^2

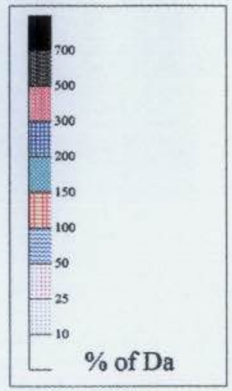


Fig. 12: Densogram – Distribution pattern of D-BR

values of each of the parameter equal or not. The boxplots represents the values of the performance parameter corresponding to the density function of the occurrence of the values of the performance parameter.

4.4.1.1. Kruskal-Wallis test

The analysis is done by determining the acceptance of the hypothesis that the means of the performance parameter (CUC, COV, DC or MAX%) corresponding to each emitter are equal.

The Appendix V shows the result of the Kruskal-Wallis tests done with the performance parameter as the dependent variable and the emitter as the independent (or grouping variable). The results clearly show that the hypothesis is rejected in all the cases (LOW, MEDIUM and HIGH operating pressure groups). It could be inferred from these results that the emitters were performing in a very dissimilar way among themselves. So, on the basis of the performance of the emitters they could easily be distinguished from each other. (The test failed to clearly explain the dissimilarity in the case of HIGH pressure group since the degree of freedom was only 1. So the test was repeated for all the ten emitters together, and the result show that there is significant variation in the mean of the different performance parameters).

4.4.1.2. Boxplot

The boxplots were drawn to visually differentiate the performance of the emitters. The boxplots also help in observing whether there was a comparable performance between any combinations of the emitters. The Appendix VI shows the boxplots of various performance parameters against the emitter for LOW, MEDIUM and HIGH operating pressure groups and for all the ten emitters together. Each of the boxplot corresponds to the values of the performance parameter in 95% confidence interval of the mean value. The box represents the values that fall in 50% confidence interval and the central line dividing the box in to two represents the median of the values of the dependent variable (the performance parameter). The longer boxplot (and/or the box) represents higher variation in the performance of the emitter (represents poorer performance) and two boxplots having their box overlapped each other in a plane represents comparable performance.

A general conclusion inferred from the boxplots is that the emitters in the MEDIUM pressure group have performance which is nearly analogous among them; emitters in HIGH pressure group perform very dissimilarly, and emitters ALBL and D-BR in the LOW pressure group have comparable performance. The emitter D-NG performs a cut above all other emitters and emitter D-LG performs inferior to all other devices.

4.4.2. Comparison by ranking

The method of ranking of the various performance parameters were used to rate the performance of the emitters from 'superior' to 'unsatisfactory'. (i.e. from rank 1 to 10). The Appendices 7 (i to iv) shows the relative ranking of various emitter-pressure combinations in different replications and the ranking of each emitter based on different performance parameters. The rating of the emitter-pressure combinations are given in Tab. 7 and final ranking of the emitters (based on the rank sum) is given in Tab. 8. The ranking is self explanatory and gives a suitable method of easy comparison of the performance of the emitters.

4.5. Performance evaluation of floppy sprinklers

The floppy sprinklers tested were not performing at the specified operating pressure range, as per the manufacturer's proposition. The prime mover used in the present study was capable of generating a water pressure of 3.5 kg/cm^2 (indicated on a sensitive pressure gauge connected to the mainline just before the emitter). Both emitters did not work well at operating pressures < 3 kg/cm^2, the rotation of the silicon tube was got halted after operating for sometime, say 10 min, so that water is sprinkled only in a vertical plane (water is applied to a small horizontal strip of land). But at an operating pressure just above 3 kg/ cm^2 the emitter JFPP started working satisfactorily for a period more than the test duration of 1 hr. Since the emitter JFLP did not work well even at 3.5 kg/cm^2, the emitter was connected directly to the mainline (the emitter was connected avoiding the riser tube) to get more applied pressure at the emitter point. But the emitter was found to be operating more or less the same as in the previous condition. So the emitter JFLP was discarded from further investigation.

The performance parameters of JFPP were calculated; shown in Tab. 9. The Fig. 13 shows the distribution pattern of JFPP. The performance parameters imply a comparatively better performance of the sprinkler. A value of COV less than 100 and higher value of DC clearly represent good performance. The densogram describes a fairly good performance of the emitter; a circular wetting pattern of gradually increasing application depth justifies the manufacturer's declaration. But the localised higher application depth zones on either side of the distribution pattern and the region of low application depth at the centre of the pattern is an indication of the operation of the emitter at a lower pressure. More studies in this direction are believed to become fruitful to the farming community.

Tab. 7: Ranking of emitter - pressure combinations, based on the total value of performance indices in different replications.

Emitter	Pressure (kg/cm^2)	Rank (COV)	Rank (CUC)	Rank (DC)	Rank (MAX%)
ALBL	1.00	4	5	7	3
	1.25	14	17	15	12
	1.50	15	13	16	11
ALGR	1.00	7	8	10	7
	1.50	17	16	19	15
	2.00	22	19	23	27
ALRD	1.50	5	3	3	13
	2.00	6	6	8	4
	2.50	11	11	11	8
JNBK	1.00	27	28	30	20
	1.50	19	24	17	17
	2.00	21	25	26	21
JNGR	1.00	16	15	12	10
	1.50	24	20	20	23
	2.00	18	22	21	19
JNWH	1.00	9	14	13	6
	1.50	19	18	18	26
	2.00	23	23	27	18
JNBL	1.00	13	9	6	16
	1.50	26	21	22	22
	2.00	25	26	24	28
D-NG	1.00	2	1	5	1
	1.25	1	2	1	2
	1.50	3	4	9	5
D-LG	1.50	30	30	28	30
	2.00	29	29	29	29
	2.50	28	27	25	24
D-BR	1.00	8	10	4	9
	1.25	10	7	2	25
	1.50	12	12	14	14

Tab. 8: Relative ranking of emitters, based on the average value of the performance indices at different pressures.

Emitter	Rank (COV)	Rank (CUC)	Rank (DC)	Rank (MAX%)	Rank Sum	Rank of emitter
ALBL	4	4	4	2	14	***3***
ALGR	5	5	7	5	22	***5***
ALRD	2	2	3	3	10	***2***
JNBK	9	9	9	8	35	***9***
JNGR	7	8	6	7	28	***7***
JNWH	6	7	8	4	25	***6***
JNBL	8	6	5	9	28	***7***
D-NG	1	1	1	1	4	***1***
D-LG	10	10	10	10	40	***10***
D-BR	3	3	2	6	14	***3***

Tab. 9: Performance of floppy sprinkler JFPP

R	670.8 cm
Da	0.195 cm
CUC	43.67 %
COV	85.98%
DC	70.2%
MAX%	483.7 %

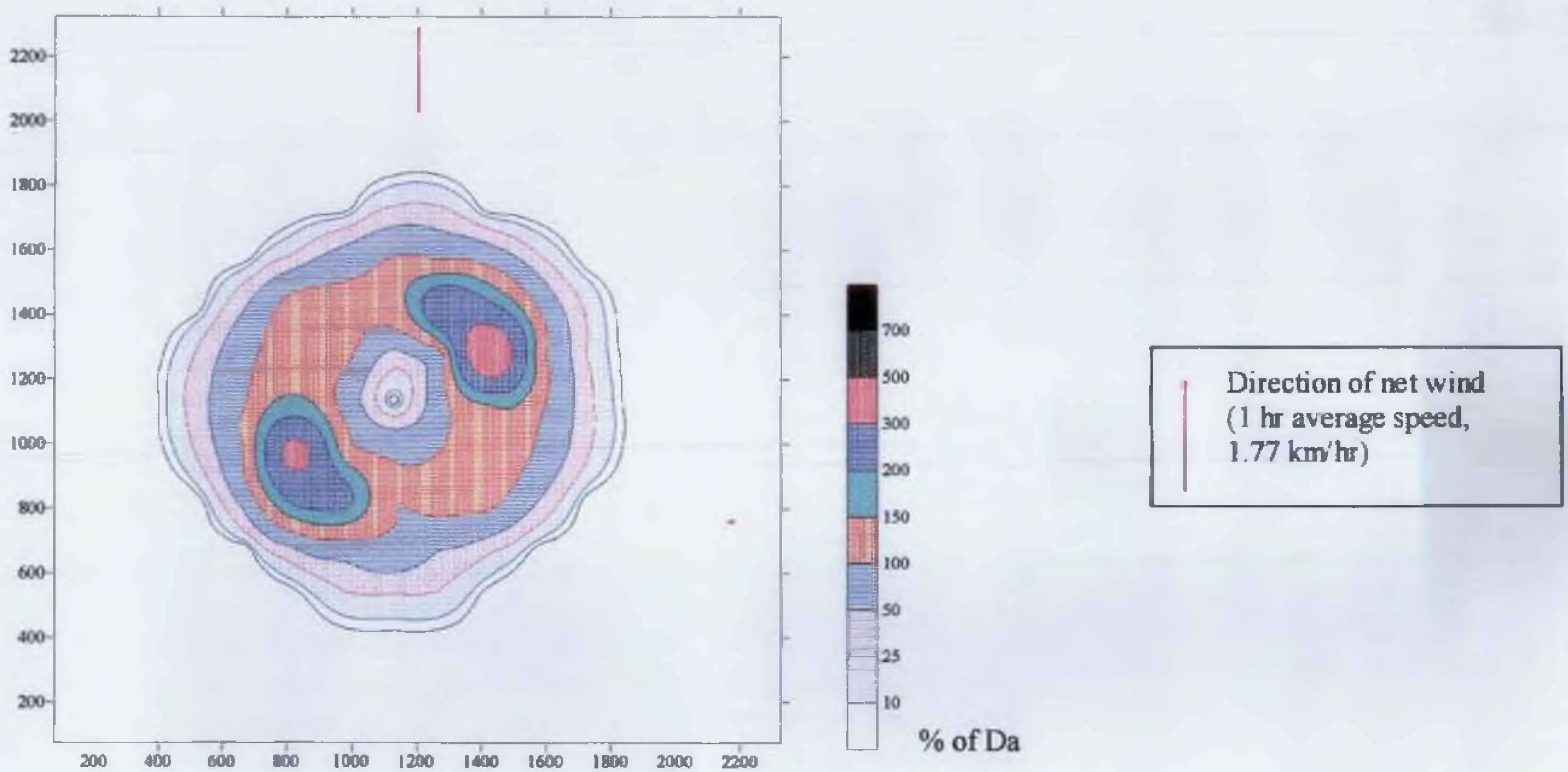


Fig. 13: Densogram – Distribution pattern of JFPP emitter at 3.0 kg/cm^2

Summary & Conclusions

SUMMARY AND CONCLUSIONS

The micro-sprinkler irrigation is the most versatile means of applying irrigation water, as it combines most of the advantages of conventional sprinkler and modern drip irrigation systems. A total of thirty micro-sprinklers (ten different models, in three replications) were tested for their individual performance and were compared and ranked based on various performance indices.

The emitters were categorised into three groups viz. single-jet self thread type, single-jet adapter type and double-jet type emitters. They were tested at three different operating pressures (at the operating pressure recommended by the manufacturer and above and below the recommended pressure) in three replications.

One important observation made during the acceptance test of the emitter is that the quality of the nozzles of the double-jet type emitters was excellent while that of the single-jet self thread type and adapter type emitters was generally poor. The quality of the nozzle is one imperative factor that affects the performance of the devices.

The determination of the application uniformity (more precisely, the distribution uniformity) of the micro-sprinkler devices was identified to be very essential in assessment of the performance of the irrigation system. The emitters were subjected to the catch-can testing and various performance parameters (CUC, COV, DC and MAX%) were calculated.

The average application depth, Da observed during the 1 hr catch-can test ranged from 0.13 cm to 0.17 cm (for emitters ALBL, ALGR, JNBK, JNGR, D-NG and D-BR); 0.17 cm to 0.19 cm (JNWH); 0.19 cm to 0.27 cm (JNBL); 0.3 cm to 0.4 cm (ALRD), and 0.52 cm to 0.56 cm (D-LG). The MAX% (ratio of highest application to the average application depth in a particular test, represented as a percentage) of single-jet self thread type, adapter type and emitter D-BR was in the range of 300 to 600, while that of the emitter D-NG was <350 and that of D-LG was >600; clearly explaining the superiority of emitter D-NG over the other emitters.

The values of the performance parameters CUC, COV and DC showed that the emitters D-NG, D-BR and ALRD perform comparatively better than the other emitters. The emitter D-LG was proved to be inferior to all other emitters in almost all of the analyses. The emitter D-NG was superior to even D-BR and ALRD because of the comparatively lower values of coefficient of variation.

The emitters in the single-jet adapter type (except JNBL) performed very poorly in contradiction to the manufacturer's assertion. Despite the fact that the single-jet self thread type emitters were put on the market without much promotion, they performed well above the expectations. Although the double-jet type emitters (except D-LG) are performing admirably, they have not been fully acknowledged yet.

The densograms (graphical representation of the water distribution) gave a better perspective of the emitter performance and an easy means of comparison. They explain how well or bad the actual distribution of water occurs over the wetted area. The graphical interpretation was easy and better than that provided by the numerical values of the performance indices.

Various statistical and ranking methods were used in an attempt to compare and grade the emitters. All the analyses have shown the superior performance of the emitter D-NG over the others. The emitters were ranked from 1 to 10 based on different performance parameters.

In general, it could be concluded that the manufacturer's data alone should not be taken into consideration while selecting the irrigation devices. From the farmers' point of view it is safer to depend more on the technical information resulting from scientific investigations. The selected devices should be assessed in the actual field conditions also to have a view of stable performance over longer runs. Similar future studies on latest devices should also be encouraged to get up to date technical data.

Suggestions for future studies:

1) Analysis of the area of distribution pattern that receive specific application rate: Appendix VIII shows the amount of area that receive water at a rate specified as a fraction or multiple of Da. Future studies may concentrate on determining 'emitter - operating condition combinations' that will optimise the area that receive water at a rate equal or near Da.
2) The use of patterns similar to CIT densogrms: The Appendix IX shows the densograms formed by varying colour shades (representing varying fractions of Dx), corresponding to the recommended operating pressure. It gives a better perspective of the varying application rates within the pattern area. The future studies should also entertain use of such patterns and analysis of those patterns using versatile software and analytical tools. The use of computer software SPACE is also appreciated.

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* originals not seen

Appendices

Appendix I: Data provided by the manufacturers

Emitter (Manufacturer)	Orifice Dia. (cm)	Remarks	Published flow rate Pressure (kg/cm^2) - Discharge (lph)		
ALBL	0.1	Available Documentation	1.00 / 38	1.25$^+$ / 42	1.50 / 46
ALGR	0.15	Available Documentation	1.00 / 85	1.50$^+$ / 105	2.00 / 120
ALRD	0.2	Available Documentation	1.50 / 150	2.00$^+$ / 175	2.50 / 200
JNBK	-	Orifice size - No data	1.00 / 39	1.50$^+$ / 46	2.00 / 51
JNWH	-	Orifice size - No data	1.00 / 48	1.50$^+$ / 55	2.00 / 61
JNGR	-	Orifice size - No data	1.00 / 69	1.50$^+$ / 83	2.00 / 93
JNBL	-	Orifice size - No data	1.00 / 110	1.50$^+$ / 130	2.00 / 153
D-NG	-	Orifice size - No data		1.25$^+$ / 60	
D-LG	0.13	Well documented data	1.50 / 64	2.00$^+$ / 75	2.50 / 83
D-BR	-	Orifice size - No data		1.25$^+$ / 104	

Note: + recommended operating pressure

Appendix II: Nomenclature of the catch-cans

Note: * The emitter is placed at the centre, i.e. H8 (450, 450)

GRID	X , Y	GRID	X , Y	GRID	X , Y	GRID	X , Y	GRID	X , Y
A1	30, 30	D1	210, 30	G1	390, 30	J1	570, 30	M1	750, 30
A2	30, 90	D2	210, 90	G2	390, 90	J2	570, 90	M2	750, 90
A3	30, 150	D3	210, 150	G3	390, 150	J3	570, 150	M3	750, 150
A4	30, 210	D4	210, 210	G4	390, 210	J4	570, 210	M4	750, 210
A5	30, 270	D5	210, 270	G5	390, 270	J5	570, 270	M5	750, 270
A6	30, 330	D6	210, 330	G6	390, 330	J6	570, 330	M6	750, 330
A7	30, 390	D7	210, 390	G7	390, 390	J7	570, 390	M7	750, 390
A8	30, 450	D8	210, 450	G8	390, 450	J8	570, 450	M8	750, 450
A9	30, 510	D9	210, 510	G9	390, 510	J9	570, 510	M9	750, 510
A10	30, 570	D10	210, 570	G10	390, 570	J10	570, 570	M10	750, 570
A11	30, 630	D11	210, 630	G11	390, 630	J11	570, 630	M11	750, 630
A12	30, 690	D12	210, 690	G12	390, 690	J12	570, 690	M12	750, 690
A13	30, 750	D13	210, 750	G13	390, 750	J13	570, 750	M13	750, 750
A14	30, 810	D14	210, 810	G14	390, 810	J14	570, 810	M14	750, 810
A15	30, 870	D15	210, 870	G15	390, 870	J15	570, 870	M15	750, 870
A16	30, 930	D16	210, 930	G16	390, 930	J16	570, 930	M16	750, 930
B1	90, 30	E1	270, 30	H1	450, 30	K1	630, 30	N1	810, 30
B2	90, 90	E2	270, 90	H2	450, 90	K2	630, 90	N2	810, 90
B3	90, 150	E3	270, 150	H3	450, 150	K3	630, 150	N3	810, 150
B4	90, 210	E4	270, 210	H4	450, 210	K4	630, 210	N4	810, 210
B5	90, 270	E5	270, 270	H5	450, 270	K5	630, 270	N5	810, 270
B6	90, 330	E6	270, 330	H6	450, 330	K6	630, 330	N6	810, 330
B7	90, 390	E7	270, 390	H7	450, 390	K7	630, 390	N7	810, 390
B8	90, 450	E8	270, 450	* H8	450, 450	K8	630, 450	N8	810, 450
B9	90, 510	E9	270, 510	H9	450, 510	K9	630, 510	N9	810, 510
B10	90, 570	E10	270, 570	H10	450, 570	K10	630, 570	N10	810, 570
B11	90, 630	E11	270, 630	H11	450, 630	K11	630, 630	N11	810, 630
B12	90, 690	E12	270, 690	H12	450, 690	K12	630, 690	N12	810, 690
B13	90, 750	E13	270, 750	H13	450, 750	K13	630, 750	N13	810, 750
B14	90, 810	E14	270, 810	H14	450, 810	K14	630, 810	N14	810, 810
B15	90, 870	E15	270, 870	H15	450, 870	K15	630, 870	N15	810, 870
B16	90, 930	E16	270, 930	H16	450, 930	K16	630, 930	N16	810, 930
C1	150, 30	F1	330, 30	I1	510, 30	L1	690, 30	O1	870, 30
C2	150, 90	F2	330, 90	I2	510, 90	L2	690, 90	O2	870, 90
C3	150, 150	F3	330, 150	I3	510, 150	L3	690, 150	O3	870, 150
C4	150, 210	F4	330, 210	I4	510, 210	L4	690, 210	O4	870, 210
C5	150, 270	F5	330, 270	I5	510, 270	L5	690, 270	O5	870, 270
C6	150, 330	F6	330, 330	I6	510, 330	L6	690, 330	O6	870, 330
C7	150, 390	F7	330, 390	I7	510, 390	L7	690, 390	O7	870, 390
C8	150, 450	F8	330, 450	I8	510, 450	L8	690, 450	O8	870, 450
C9	150, 510	F9	330, 510	I9	510, 510	L9	690, 510	O9	870, 510
C10	150, 570	F10	330, 570	I10	510, 570	L10	690, 570	O10	870, 570
C11	150, 630	F11	330, 630	I11	510, 630	L11	690, 630	O11	870, 630
C12	150, 690	F12	330, 690	I12	510, 690	L12	690, 690	O12	870, 690
C13	150, 750	F13	330, 750	I13	510, 750	L13	690, 750	O13	870, 750
C14	150, 810	F14	330, 810	I14	510, 810	L14	690, 810	O14	870, 810
C15	150, 870	F15	330, 870	I15	510, 870	L15	690, 870	O15	870, 870
C16	150, 930	F16	330, 930	I16	510, 930	L16	690, 930	O16	870, 930

Appendix III: Travelling microscope - Nozzle size, shape and quality

Emitter (Replication)	Orifice Dia. (mm)	Remarks	Emitter (Replication)	Orifice Dia. (mm)	Remarks
ALBL : R1	0.9	satisfactory nozzle edges	JNGR : R1 *	1.05, 0.98	satisfactory, but oval shaped nozzle
ALBL : R2	0.89	irregular edges	JNGR : R2 *	0.92, 1.05	satisfactory, but oval shaped nozzle
ALBL : R3 *	0.67, 0.77	highly irregular, square shaped nozzle	JNGR : R3 *	1.1, 1.07	irregular edges
ALGR : R1	1.06	satisfactory nozzle edges	JNBL : R1	1.78	satisfactory, slightly oval shaped
ALGR : R2	1.1	minor irregularities	JNBL : R2	1.78	satisfactory, slightly oval shaped
ALGR : R3 *	0.84, 0.68	highly irregular, triangular nozzle	JNBL : R3	1.96	satisfactory, slightly oval shaped
ALRD : R1	1.8	satisfactory nozzle edges	D-NG : R1	1.21	perfect circular shape - fine edges
ALRD : R2	1.8	satisfactory, almost circular shape	D-NG : R2	1.21	perfect circular shape - fine edges
ALRD : R3 *	1.87, 1.8	satisfactory, but oval shaped nozzle	D-NG : R3	1.21	perfect circular shape
JNBK : R1	0.92	satisfactory nozzle edges	D-LG : R1	1.7	circular shape - very fine edges
JNBK : R2	0.79	minor irregularities	D-LG : R2	1.7	circular shape - very fine edges
JNBK : R3 *	0.79, 1	highly irregular edges	D-LG : R3	1.7	circular shape - very fine edges
JNWH : R1	1.02	very good nozzle edges	D-BR : R1	1.68	perfect circular shape - very fine edges
JNWH : R2	1.1	satisfactory nozzle edges	D-BR : R2	1.68	perfect circular shape - very fine edges
JNWH : R3 *	0.66, 1.1	highly irregular edges and shape	D-BR : R3	1.68	perfect circular shape - very fine edges

Note: * The values given for orifice dia. were measured in two directions at right angles to each other

Appendix IV(1): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALBL. Temp. (°C) Initial: 27.0 Final: 29.5
Pressure (kg/cm²): 1.00
Replication: R1 Rel. Hum. (%) Initial: 91.0 Final: 91.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4		M4	
A5		D5		G5	14	J5	8	M5	
A6		D6		G6	27	J6	21	M6	
A7		D7		G7	38	J7	27	M7	
► A8		D8		G8	54	J8	38	M8	
A9		D9		G9	22	J9	25	M9	
A10		D10		G10	18	J10	18	M10	
A11		D11		G11	12	J11	14	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	7	K4		N4	
B5		E5		H5	12	K5		N5	
B6		E6	4	H6	21	K6	11	N6	
B7		E7		H7	32	K7	17	N7	
B8		E8	18	☼ H8		K8	22	N8	
B9		E9	15	H9	34	K9	15	N9	
B10		E10	7	H10	23	K10	12	N10	
B11		E11		H11	11	K11	9	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	9	I5	9	L5		O5	
C6		F6	21	I6	18	L6		O6	
C7		F7	30	I7	44	L7	6	O7	
C8		F8	24	I8	53	L8	11	O8	
C9		F9	18	I9	41	L9	8	O9	
C10		F10	16	I10	27	L10	4	O10	
C11		F11	5	I11	13	L11	5	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(2): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALBL Temp. (°C) Initial: 29.0 Final: 28.5
Pressure (kg/cm²): 1.00
Replication: R2 Rel. Hum. (%) Initial: 88.5 Final: 90.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	4	J4		M4	
A5		D5		G5	12	J5	5	M5	
A6		D6		G6	25	J6	17	M6	
A7		D7		G7	40	J7	25	M7	
► A8		D8		G8	63	J8	41	M8	
A9		D9		G9	19	J9	20	M9	
A10		D10		G10	26	J10	33	M10	
A11		D11		G11	14	J11	19	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	13	K5		N5	
B6		E6	4	H6	20	K6	9	N6	
B7		E7		H7	29	K7	18	N7	
B8		E8	24	☼ H8		K8	19	N8	
B9		E9	13	H9	34	K9	17	N9	
B10		E10	9	H10	27	K10	14	N10	
B11		E11		H11	4	K11	30	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	6	I5	7	L5		O5	
C6		F6	37	I6	22	L6		O6	
C7		F7	38	I7	47	L7	8	O7	
C8		F8	17	I8	56	L8	10	O8	
C9		F9	22	I9	58	L9	9	O9	
C10		F10	24	I10	50	L10	4	O10	
C11		F11	6	I11	8	L11	4	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(3): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALBL Temp. (°C) Initial: 28.0 Final: 28.5
Pressure (kg/cm²): 1.00
Replication: R3 Rel. Hum. (%) Initial: 91.0 Final: 90.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4		M4	
A5		D5		G5	11	J5	7	M5	
A6		D6		G6	22	J6	22	M6	
A7		D7		G7	35	J7	32	M7	
► A8		D8		G8	55	J8	29	M8	
A9		D9		G9	17	J9	14	M9	
A10		D10		G10	23	J10	13	M10	
A11		D11		G11	13	J11	10	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	12	K5		N5	
B6		E6	4	H6	18	K6	7	N6	
B7		E7		H7	26	K7	13	N7	
B8		E8	16	☼ H8		K8	14	N8	
B9		E9	12	H9	30	K9	12	N9	
B10		E10	8	H10	24	K10	10	N10	
B11		E11		H11	6	K11	9	N11	
B12		E12		H12	6	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	6	I5	9	L5		O5	
C6		F6	19	I6	28	L6		O6	
C7		F7	27	I7	60	L7	6	O7	
C8		F8	21	I8	72	L8	7	O8	
C9		F9	16	I9	74	L9	7	O9	
C10		F10	14	I10	35	L10	5	O10	
C11		F11	6	I11	11	L11	4	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(4): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALBL Temp. (°C) Initial: 30.0 Final: 29.0
Pressure (kg/cm²): 1.25
Replication: R1 Rel. Hum. (%) Initial: 85.0 Final: 87.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	12	J5	5	M5	
A6		D6		G6	24	J6	16	M6	
A7		D7		G7	57	J7	32	M7	
► A8		D8	8	G8	46	J8	54	M8	
A9		D9	4	G9	27	J9	39	M9	
A10		D10	4	G10	38	J10	26	M10	
A11		D11		G11	15	J11	7	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	18	K5		N5	
B6		E6	13	H6	21	K6	8	N6	
B7		E7	6	H7	34	K7	22	N7	
B8		E8	16	☼ H8		K8	27	N8	
B9		E9	17	H9	74	K9	27	N9	
B10		E10	13	H10	38	K10	8	N10	
B11		E11	4	H11	39	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	4	I4	4	L4		O4	
C5		F5	11	I5	7	L5		O5	
C6		F6	54	I6	22	L6		O6	
C7		F7	28	I7	49	L7	4	O7	
C8		F8	11	I8	76	L8	11	O8	
C9		F9	18	I9	81	L9	4	O9	
C10		F10	27	I10	39	L10		O10	
C11		F11	7	I11	17	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(5): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALBL	Temp (°c)	Initial	28.5
Pressure (kg/cm²)	1.25		Final	29.5
Replication	R2	Rel Hum (%)	Initial	90.5
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	8	J4		M4	
A5		D5		G5	10	J5	6	M5	
A6		D6		G6	22	J6	13	M6	
A7		D7		G7	60	J7	30	M7	
► A8		D8		G8	54	J8	58	M8	
A9		D9		G9	23	J9	31	M9	
A10		D10		G10	55	J10	48	M10	
A11		D11		G11	18	J11	10	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	20	K5		N5	
B6		E6	13	H6	20	K6	7	N6	
B7		E7		H7	31	K7	23	N7	
B8		E8	21	○ H8		K8	23	N8	
B9		E9	15	H9	74	K9	31	N9	
B10		E10	17	H10	45	K10	9	N10	
B11		E11		H11	14	K11	5	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	7	I5	5	L5		O5	
C6		F6	95	I6	27	L6		O6	
C7		F7	15	I7	52	L7	5	O7	
C8		F8	8	I8	80	L8	10	O8	
C9		F9	22	I9	115	L9	5	O9	
C10		F10	41	I10	72	L10	4	O10	
C11		F11	8	I11	10	L11	4	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(6): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALBL	Temp (°c)	Initial	27.0
Pressure (kg/cm²)	1.25		Final	28.0
Replication	R3	Rel Hum (%)	Initial	92.0
Duration (hr)	1.00		Final	90.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	8	J4		M4	
A5		D5		G5	9	J5	8	M5	
A6		D6		G6	20	J6	17	M6	
A7		D7		G7	54	J7	39	M7	
► A8		D8		G8	49	J8	37	M8	
A9		D9		G9	21	J9	20	M9	
A10		D10		G10	50	J10	31	M10	
A11		D11		G11	17	J11	7	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	18	K5		N5	
B6		E6	12	H6	19	K6	5	N6	
B7		E7		H7	28	K7	15	N7	
B8		E8	19	○ H8		K8	15	N8	
B9		E9	14	H9	67	K9	20	N9	
B10		E10	16	H10	41	K10	6	N10	
B11		E11		H11	19	K11	4	N11	
B12		E12		H12	6	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	7	I5	7	L5		O5	
C6		F6	58	I6	35	L6		O6	
C7		F7	32	I7	68	L7	4	O7	
C8		F8	8	I8	104	L8	7	O8	
C9		F9	20	I9	149	L9	4	O9	
C10		F10	37	I10	93	L10	5	O10	
C11		F11	8	I11	13	L11	4	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(7): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALBL	Temp (°c)	Initial	28.5
Pressure (kg/cm²)	1.50		Final	28.0
Replication	R1	Rel Hum (%)	Initial	87.0
Duration (hr)	1.00		Final	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	8	J5		M5	
A6		D6		G6	37	J6	24	M6	
A7		D7		G7	81	J7	40	M7	
► A8		D8	12	G8	46	J8	42	M8	
A9		D9	1	G9	40	J9	25	M9	
A10		D10		G10	25	J10	27	M10	
A11		D11		G11	38	J11	12	M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	10	K5		N5	
B6		E6	11	H6	27	K6	8	N6	
B7		E7		H7	40	K7	23	N7	
B8		E8	12	○ H8		K8	30	N8	
B9		E9	13	H9	64	K9	28	N9	
B10		E10	13	H10	23	K10	12	N10	
B11		E11	5	H11	22	K11		N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	11	I5	7	L5		O5	
C6		F6	62	I6	23	L6		O6	
C7		F7	28	I7	54	L7	6	O7	
C8		F8	12	I8	65	L8	7	O8	
C9		F9	17	I9	82	L9	4	O9	
C10		F10	18	I10	56	L10		O10	
C11		F11	9	I11	27	L11		O11	
C12		F12		I12	9	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(8): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALBL	Temp (°c)	Initial	27.0
Pressure (kg/cm²)	1.50		Final	27.5
Replication	R2	Rel Hum (%)	Initial	92.0
Duration (hr)	1.00		Final	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4		M4	
A5		D5		G5	7	J5	8	M5	
A6		D6		G6	35	J6	17	M6	
A7		D7		G7	86	J7	38	M7	
► A8		D8		G8	54	J8	46	M8	
A9		D9		G9	35	J9	20	M9	
A10		D10		G10	37	J10	50	M10	
A11		D11		G11	21	J11	17	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	7	K4		N4	
B5		E5		H5	11	K5		N5	
B6		E6	13	H6	26	K6	7	N6	
B7		E7		H7	37	K7	25	N7	
B8		E8	16	○ H8		K8	26	N8	
B9		E9	12	H9	64	K9	12	N9	
B10		E10	17	H10	27	K10	14	N10	
B11		E11		H11	8	K11	5	N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	8	I5	6	L5		O5	
C6		F6	110	I6	29	L6		O6	
C7		F7	36	I7	58	L7	8	O7	
C8		F8	9	I8	69	L8	7	O8	
C9		F9	21	I9	116	L9	5	O9	
C10		F10	27	I10	104	L10	4	O10	
C11		F11	11	I11	17	L11	6	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(9): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALBL Temp (°C) Initial: 28.0 Final: 29.5
Pressure (kg/cm²): 1.50 Rel. Hum. (%) Initial: 90.5 Final: 89.0
Replication: R3
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4		M4	
A5		D5		G5	6	J5	11	M5	
A6		D6		G6	29	J6	22	M6	
A7		D7		G7	71	J7	28	M7	
► A8		D8		G8	45	J8	34	M8	
A9		D9		G9	29	J9	15	M9	
A10		D10		G10	31	J10	37	M10	
A11		D11		G11	18	J11	13	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	6	K4		N4	
B5		E5		H5	10	K5		N5	
B6		E6	11	H6	22	K6	6	N6	
B7		E7		H7	31	K7	19	N7	
B8		E8	14	○ H8		K8	19	N8	
B9		E9	10	H9	53	K9	24	N9	
B10		E10	12	H10	23	K10	11	N10	
B11		E11		H11	11	K11	4	N11	
B12		E12		H12	12	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5	7	I5	8	L5		O5	
C6		F6	72	I6	38	L6		O6	
C7		F7	30	I7	75	L7	6	O7	
C8		F8	8	I8	89	L8	6	O8	
C9		F9	18	I9	149	L9	4	O9	
C10		F10	23	I10	134	L10	3	O10	
C11		F11	10	I11	22	L11	5	O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(10): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALOR Temp (°C) Initial: 27.0 Final: 27.5
Pressure (kg/cm²): 1.00 Rel. Hum. (%) Initial: 92.5 Final: 91.0
Replication: R1
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	4	J4		M4	
A5		D5		G5	74	J5	17	M5	
A6		D6	4	G6	85	J6	16	M6	
A7		D7		G7	63	J7	13	M7	
► A8		D8		G8	30	J8	15	M8	
A9		D9		G9	27	J9	46	M9	
A10		D10		G10	59	J10	37	M10	
A11		D11		G11	10	J11	12	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	8	K4		N4	
B5		E5	4	H5	29	K5	8	N5	
B6		E6	20	H6	26	K6	10	N6	
B7		E7	10	H7	24	K7	14	N7	
B8		E8	13	○ H8		K8	17	N8	
B9		E9	22	H9	39	K9	15	N9	
B10		E10	4	H10	36	K10	12	N10	
B11		E11		H11	28	K11	4	N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	4	L4		O4	
C5		F5	36	I5	24	L5		O5	
C6		F6	54	I6	19	L6	6	O6	
C7		F7	40	I7	12	L7	7	O7	
C8		F8	11	I8	23	L8	6	O8	
C9		F9	52	I9	75	L9	6	O9	
C10		F10	48	I10	38	L10		O10	
C11		F11		I11	23	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(11) Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALOR Temp. (°C) Initial: 30.0 Final: 29.0
Pressure (kg/cm²): 1.00 Rel. Hum. (%) Initial: 87.5 Final: 88.0
Replication: R2
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	6	J4		M4	
A5		D5		G5	82	J5	15	M5	
A6		D6	4	G6	76	J6	11	M6	
A7		D7		G7	58	J7	16	M7	
► A8		D8		G8	36	J8	13	M8	
A9		D9		G9	29	J9	54	M9	
A10		D10		G10	49	J10	30	M10	
A11		D11		G11	16	J11	17	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	9	K4		N4	
B5		E5	5	H5	24	K5	4	N5	
B6		E6	18	H6	31	K6	12	N6	
B7		E7	11	H7	28	K7	18	N7	
B8		E8	14	○ H8		K8	14	N8	
B9		E9	25	H9	44	K9	19	N9	
B10		E10	4	H10	38	K10	10	N10	
B11		E11		H11	21	K11	6	N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	8	L4		O4	
C5		F5	34	I5	20	L5		O5	
C6		F6	48	I6	17	L6	5	O6	
C7		F7	12	I7	11	L7	4	O7	
C8		F8	12	I8	25	L8	8	O8	
C9		F9	51	I9	69	L9	5	O9	
C10		F10	41	I10	32	L10		O10	
C11		F11		I11	24	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(12): Catch-can data (Amount of water obtained in catch-cans)

Emitter: ALOR Temp (°C) Initial: 28.0 Final: 28.5
Pressure (kg/cm²): 1.00 Rel. Hum (%) Initial: 91.0 Final: 89.5
Replication: R3
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4		M4	
A5		D5		G5	79	J5	12	M5	
A6		D6	5	G6	60	J6	9	M6	
A7		D7		G7	54	J7	18	M7	
► A8		D8		G8	24	J8	14	M8	
A9		D9		G9	21	J9	39	M9	
A10		D10		G10	37	J10	26	M10	
A11		D11		G11	15	J11	14	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	5	K4		N4	
B5		E5	4	H5	18	K5	5	N5	
B6		E6	18	H6	26	K6	9	N6	
B7		E7	8	H7	30	K7	28	N7	
B8		E8	16	○ H8		K8	7	N8	
B9		E9	23	H9	35	K9	9	N9	
B10		E10	5	H10	29	K10	6	N10	
B11		E11		H11	18	K11	4	N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	6	L4		O4	
C5		F5	27	I5	9	L5		O5	
C6		F6	15	I6	21	L6	4	O6	
C7		F7	25	I7	12	L7	5	O7	
C8		F8	8	I8	10	L8	4	O8	
C9		F9	49	I9	48	L9	4	O9	
C10		F10	32	I10	29	L10		O10	
C11		F11		I11	21	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(13): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	ALGR	Temp. (°C)	Initial:	28.0
Pressure (kg/cm²):	1.50		Final:	30.0
Replication:	R1	Rel. Hum. (%)	Initial:	89.0
Duration (hr):	1.00		Final:	88.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	8	J4	4	M4	
A5		D5		G5	50	J5	13	M5	
A6		D6		G6	98	J6	20	M6	
A7		D7		G7	135	J7	19	M7	
► A8		D8		G8	35	J8	23	M8	5
A9		D9	4	G9	65	J9	52	M9	4
A10		D10		G10	57	J10	36	M10	
A11		D11		G11	24	J11	22	M11	
A12		D12		G12		J12	4	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	10	K4		N4	
B5		E5	10	H5	31	K5	10	N5	
B6		E6	27	H6	34	K6	13	N6	
B7		E7	24	H7	42	K7	13	N7	
B8		E8	14	○ H8		K8	14	N8	
B9		E9	27	H9	96	K9	16	N9	
B10		E10	10	H10	49	K10	18	N10	
B11		E11		H11	27	K11	9	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	6	I4	4	L4		O4	
C5		F5	51	I5	20	L5	5	O5	
C6		F6	57	I6	27	L6	7	O6	
C7		F7	49	I7	34	L7	7	O7	
C8		F8	14	I8	64	L8	8	O8	
C9		F9	52	I9	91	L9	7	O9	
C10		F10	49	I10	41	L10	7	O10	
C11		F11	11	I11	29	L11		O11	
C12		F12		I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(14): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	ALGR	Temp. (°C)	Initial:	29.5
Pressure (kg/cm²):	1.50		Final:	28.5
Replication:	R2	Rel. Hum. (%)	Initial:	88.5
Duration (hr):	1.00		Final:	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	7	J4	4	M4	
A5		D5		G5	45	J5	11	M5	
A6		D6		G6	106	J6	21	M6	
A7		D7		G7	142	J7	17	M7	
► A8		D8		G8	29	J8	29	M8	7
A9		D9	5	G9	54	J9	64	M9	4
A10		D10		G10	69	J10	28	M10	
A11		D11		G11	21	J11	18	M11	
A12		D12		G12		J12	7	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	7	K4		N4	
B5		E5	11	H5	32	K5	12	N5	
B6		E6	26	H6	41	K6	15	N6	
B7		E7	28	H7	37	K7	17	N7	
B8		E8	12	○ H8		K8	12	N8	
B9		E9	23	H9	85	K9	14	N9	
B10		E10	9	H10	43	K10	19	N10	
B11		E11		H11	24	K11	6	N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	7	I4	6	L4		O4	
C5		F5	48	I5	11	L5	4	O5	
C6		F6	64	I6	25	L6	9	O6	
C7		F7	38	I7	38	L7	5	O7	
C8		F8	12	I8	59	L8	6	O8	
C9		F9	57	I9	102	L9	4	O9	
C10		F10	42	I10	32	L10	4	O10	
C11		F11	13	I11	24	L11		O11	
C12		F12		I12	12	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(15): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	ALGR	Temp. (°C)	Initial:	28.0
Pressure (kg/cm²):	1.50		Final:	28.5
Replication:	R3	Rel. Hum. (%)	Initial:	90.0
Duration (hr):	1.00		Final:	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	8	J4	5	M4	
A5		D5		G5	36	J5	12	M5	
A6		D6		G6	85	J6	22	M6	
A7		D7		G7	112	J7	13	M7	
► A8		D8		G8	14	J8	24	M8	4
A9		D9	4	G9	36	J9	49	M9	5
A10		D10		G10	39	J10	23	M10	
A11		D11		G11	21	J11	12	M11	
A12		D12		G12		J12	8	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	5	K4		N4	
B5		E5	9	H5	21	K5	14	N5	
B6		E6	29	H6	38	K6	11	N6	
B7		E7	17	H7	25	K7	14	N7	
B8		E8	11	○ H8		K8	9	N8	
B9		E9	20	H9	74	K9	11	N9	
B10		E10	6	H10	38	K10	15	N10	
B11		E11		H11	19	K11	4	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	4	I4	7	L4		O4	
C5		F5	32	I5	12	L5	4	O5	
C6		F6	61	I6	21	L6	5	O6	
C7		F7	29	I7	26	L7	4	O7	
C8		F8	9	I8	42	L8	4	O8	
C9		F9	48	I9	95	L9	5	O9	
C10		F10	32	I10	30	L10	4	O10	
C11		F11	11	I11	22	L11		O11	
C12		F12		I12	9	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(16): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	ALGR	Temp. (°C)	Initial:	29.0
Pressure (kg/cm²):	2.00		Final:	30.0
Replication:	B1	Rel. Hum. (%)	Initial:	88.5
Duration (hr):	1.00		Final:	87.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	7	J4	4	M4	
A5		D5		G5	36	J5	12	M5	
A6		D6	6	G6	92	J6	22	M6	
A7		D7		G7	200	J7	21	M7	5
► A8		D8		G8	27	J8	26	M8	7
A9		D9	8	G9	68	J9	67	M9	6
A10		D10		G10	55	J10	35	M10	
A11		D11		G11	32	J11	21	M11	
A12		D12		G12	11	J12	4	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5	19	H5	33	K5	10	N5	
B6		E6	26	H6	40	K6	13	N6	
B7		E7	27	H7	62	K7	15	N7	
B8		E8	6	○ H8		K8	17	N8	
B9		E9	23	H9	132	K9	20	N9	
B10		E10	22	H10	63	K10	22	N10	
B11		E11	12	H11	34	K11	15	N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	7	I4		L4		O4	
C5		F5	60	I5	18	L5	7	O5	
C6		F6	63	I6	32	L6	8	O6	
C7		F7	48	I7	40	L7	10	O7	
C8		F8	10	I8	77	L8	11	O8	
C9		F9	48	I9	98	L9	12	O9	
C10		F10	46	I10	38	L10	10	O10	
C11		F11	22	I11	23	L11	4	O11	
C12		F12	12	I12	6	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(17): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALGR	Temp. (°C)	Initial:	28.0
Pressure (kg/cm²)	2.00		Final:	29.0
Replication	R2	Rel. Hum. (%)	Initial:	90.0
Duration (hr)	1.00		Final:	89.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	6	J4	5	M4	
A5		D5		G5	34	J5	10	M5	
A6		D6	7	G6	104	J6	23	M6	
A7		D7		G7	186	J7	16	M7	6
► A8		D8		G8	28	J8	21	M8	4
A9		D9	5	G9	72	J9	72	M9	9
A10		D10		G10	53	J10	41	M10	
A11		D11		G11	28	J11	17	M11	
A12		D12		G12	14	J12	6	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	5	K4		N4	
B5		E5	14	H5	29	K5	9	N5	
B6		E6	28	H6	44	K6	8	N6	
B7		E7	21	H7	53	K7	16	N7	
B8		E8	7	☼ H8		K8	19	N8	
B9		E9	26	H9	141	K9	15	N9	
B10		E10	18	H10	67	K10	21	N10	
B11		E11	14	H11	28	K11	13	N11	
B12		E12		H12	10	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	5	I4		L4		O4	
C5		F5	67	I5	14	L5	6	O5	
C6		F6	58	I6	35	L6	14	O6	
C7		F7	44	I7	41	L7	9	O7	
C8		F8	12	I8	69	L8	13	O8	
C9		F9	43	I9	103	L9	8	O9	
C10		F10	44	I10	39	L10	7	O10	
C11		F11	19	I11	18	L11	4	O11	
C12		F12	13	I12	7	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(18): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALGR	Temp. (°C)	Initial	27.5
Pressure (kg/cm²)	2.00		Final	27.5
Replication	R3	Rel. Hum. (%)	Initial	92.0
Duration (hr)	1.00		Final	91.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	4	J4	4	M4	
A5		D5		G5	28	J5	8	M5	
A6		D6	4	G6	114	J6	18	M6	
A7		D7		G7	143	J7	11	M7	4
► A8		D8		G8	21	J8	17	M8	4
A9		D9	4	G9	64	J9	62	M9	5
A10		D10		G10	39	J10	38	M10	
A11		D11		G11	23	J11	11	M11	
A12		D12		G12	10	J12	4	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	6	K4		N4	
B5		E5	11	H5	18	K5	5	N5	
B6		E6	24	H6	36	K6	9	N6	
B7		E7	17	H7	40	K7	12	N7	
B8		E8	5	☼ H8		K8	16	N8	
B9		E9	28	H9	125	K9	10	N9	
B10		E10	15	H10	43	K10	16	N10	
B11		E11	31	H11	24	K11	10	N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4	4	I4		L4		O4	
C5		F5	49	I5	11	L5	5	O5	
C6		F6	61	I6	36	L6	9	O6	
C7		F7	32	I7	49	L7	11	O7	
C8		F8	31	I8	52	L8	9	O8	
C9		F9	38	I9	86	L9	6	O9	
C10		F10	47	I10	31	L10	4	O10	
C11		F11	18	I11	13	L11	4	O11	
C12		F12	11	I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(19): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp. (°C)	Initial:	29.0
Pressure (kg/cm²)	1.50		Final:	30.5
Replication	R1	Rel. Hum. (%)	Initial:	90.0
Duration (hr)	1.00		Final	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	51	J4	29	M4	
A5		D5		G5	86	J5	78	M5	
A6		D6	6	G6	142	J6	64	M6	
A7		D7		G7	81	J7	82	M7	
► A8		D8	48	G8	72	J8	80	M8	
A9		D9	5	G9	97	J9	53	M9	
A10		D10	5	G10	75	J10	53	M10	
A11		D11		G11	51	J11	39	M11	
A12		D12		G12	11	J12	8	M12	
A13		D13		G13	4	J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4		H4	65	K4	4	N4	
B5		E5	20	H5	94	K5	37	N5	
B6		E6	55	H6	75	K6	64	N6	
B7		E7	29	H7	54	K7	51	N7	
B8		E8	143	☼ H8		K8	39	N8	
B9		E9	99	H9	75	K9	56	N9	
B10		E10	30	H10	94	K10	54	N10	
B11		E11		H11	58	K11	16	N11	
B12		E12		H12	23	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	4	L3		O3	
C4		F4	14	I4	66	L4		O4	
C5		F5	69	I5	80	L5	4	O5	
C6		F6	87	I6	78	L6	22	O6	
C7		F7	179	I7	74	L7	41	O7	
C8		F8	248	I8	74	L8	45	O8	
C9		F9	123	I9	64	L9	34	O9	
C10		F10	75	I10	65	L10	9	O10	
C11		F11	37	I11	48	L11		O11	
C12		F12		I12	17	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(20): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp. (°C)	Initial	30.0
Pressure (kg/cm²)	1.50		Final	28.5
Replication	R2	Rel. Hum. (%)	Initial	87.0
Duration (hr)	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	53	J4	24	M4	
A5		D5		G5	91	J5	81	M5	
A6		D6	6	G6	140	J6	59	M6	
A7		D7		G7	78	J7	87	M7	
► A8		D8	51	G8	78	J8	79	M8	
A9		D9	5	G9	94	J9	51	M9	
A10		D10	4	G10	72	J10	54	M10	
A11		D11		G11	50	J11	35	M11	
A12		D12		G12	16	J12	9	M12	
A13		D13		G13	6	J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	5	K3		N3	
B4		E4		H4	63	K4	5	N4	
B5		E5	19	H5	91	K5	33	N5	
B6		E6	60	H6	73	K6	66	N6	
B7		E7	28	H7	58	K7	55	N7	
B8		E8	136	☼ H8		K8	37	N8	
B9		E9	92	H9	79	K9	57	N9	
B10		E10	28	H10	96	K10	54	N10	
B11		E11		H11	61	K11	17	N11	
B12		E12		H12	20	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	6	L3		O3	
C4		F4	12	I4	65	L4		O4	
C5		F5	64	I5	88	L5	6	O5	
C6		F6	89	I6	73	L6	25	O6	
C7		F7	182	I7	79	L7	40	O7	
C8		F8	261	I8	73	L8	48	O8	
C9		F9	120	I9	61	L9	37	O9	
C10		F10	77	I10	64	L10	10	O10	
C11		F11	40	I11	51	L11		O11	
C12		F12		I12	19	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(21): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp (°C)	Initial:	28.0
Pressure (kg/cm²)	1.50		Final:	29.5
Replication	R3	Rel. Hum. (%)	Initial:	91.0
Duration (hr)	1.00		Final:	89.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	54	J4	18	M4	
A5		D5		G5	95	J5	84	M5	
A6		D6	5	G6	138	J6	53	M6	
A7		D7		G7	75	J7	91	M7	
► A8		D8	54	G8	84	J8	77	M8	
A9		D9	4	G9	90	J9	48	M9	
A10		D10	5	G10	69	J10	54	M10	
A11		D11		G11	48	J11	31	M11	
A12		D12		G12	21	J12	9	M12	
A13		D13		G13	7	J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	5	K3		N3	
B4		E4		H4	60	K4	5	N4	
B5		E5	18	H5	88	K5	28	N5	
B6		E6	64	H6	71	K6	67	N6	
B7		E7	27	H7	62	K7	59	N7	
B8		E8	128	○ H8		K8	35	N8	
B9		E9	84	H9	82	K9	58	N9	
B10		E10	26	H10	102	K10	53	N10	
B11		E11		H11	64	K11	17	N11	
B12		E12		H12	17	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	7	L3		O3	
C4		F4	9	I4	64	L4		O4	
C5		F5	58	I5	95	L5	7	O5	
C6		F6	91	I6	68	L6	28	O6	
C7		F7	184	I7	83	L7	38	O7	
C8		F8	283	I8	71	L8	51	O8	
C9		F9	116	I9	58	L9	39	O9	
C10		F10	78	I10	62	L10	11	O10	
C11		F11	42	I11	54	L11		O11	
C12		F12		I12	21	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(22): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp (°C)	Initial	27.5
Pressure (kg/cm²)	2.00		Final	28.0
Replication	R1	Rel. Hum. (%)	Initial	92.0
Duration (hr)	1.00		Final	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	28	J3	5	M3	
A4		D4	5	G4	53	J4	45	M4	
A5		D5	17	G5	73	J5	60	M5	
A6		D6	38	G6	139	J6	50	M6	8
A7		D7	42	G7	128	J7	62	M7	3
► A8		D8	5	G8	44	J8	55	M8	13
A9		D9	32	G9	127	J9	47	M9	8
A10		D10	22	G10	65	J10	42	M10	8
A11		D11	7	G11	50	J11	44	M11	
A12		D12		G12	26	J12	23	M12	
A13		D13		G13		J13	4	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	37	K3		N3	
B4		E4	19	H4	72	K4	21	N4	
B5		E5	40	H5	76	K5	50	N5	
B6		E6	53	H6	133	K6	53	N6	
B7		E7	72	H7	92	K7	48	N7	
B8		E8	18	○ H8		K8	42	N8	
B9		E9	72	H9	98	K9	52	N9	
B10		E10	50	H10	87	K10	43	N10	
B11		E11	54	H11	51	K11	29	N11	
B12		E12		H12	35	K12	10	N12	
B13		E13		H13	5	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	12	I3	23	L3		O3	
C4		F4	40	I4	63	L4	5	O4	
C5		F5	55	I5	72	L5	35	O5	
C6	7	F6	71	I6	79	L6	38	O6	
C7	7	F7	133	I7	153	L7	40	O7	
C8		F8	39	I8	142	L8	47	O8	
C9	13	F9	146	I9	94	L9	37	O9	
C10		F10	70	I10	76	L10	25	O10	
C11		F11	51	I11	47	L11	13	O11	
C12		F12	18	I12	34	L12		O12	
C13		F13		I13	7	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(23): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp (°C)	Initial:	26.5
Pressure (kg/cm²)	2.00		Final.	27.0
Replication	R2	Rel. Hum. (%)	Initial	92.0
Duration (hr)	1.00		Final:	92.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	28	J3	5	M3	
A4		D4	5	G4	57	J4	46	M4	
A5		D5	16	G5	74	J5	59	M5	
A6		D6	37	G6	129	J6	46	M6	9
A7		D7	43	G7	126	J7	66	M7	14
► A8		D8	6	G8	41	J8	53	M8	12
A9		D9	30	G9	123	J9	45	M9	8
A10		D10	20	G10	68	J10	40	M10	7
A11		D11	8	G11	49	J11	48	M11	
A12		D12		G12	24	J12	19	M12	
A13		D13		G13		J13	6	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	35	K3		N3	
B4		E4	17	H4	75	K4	19	N4	
B5		E5	41	H5	75	K5	52	N5	
B6		E6	51	H6	139	K6	56	N6	
B7		E7	75	H7	89	K7	44	N7	
B8		E8	16	○ H8		K8	44	N8	
B9		E9	77	H9	96	K9	55	N9	
B10		E10	47	H10	85	K10	42	N10	
B11		E11	55	H11	55	K11	27	N11	
B12		E12		H12	38	K12	10	N12	
B13		E13		H13	4	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	11	I3	22	L3		O3	
C4		F4	42	I4	66	L4	5	O4	
C5		F5	54	I5	71	L5	16	O5	
C6	8	F6	70	I6	82	L6	40	O6	
C7	6	F7	137	I7	146	L7	36	O7	
C8		F8	29	I8	147	L8	48	O8	
C9	13	F9	138	I9	88	L9	36	O9	
C10		F10	73	I10	75	L10	22	O10	
C11		F11	50	I11	43	L11	14	O11	
C12		F12	15	I12	36	L12		O12	
C13		F13		I13	10	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: A36 denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(24): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	ALRD	Temp (°C)	Initial	29.0
Pressure (kg/cm²).	2.00		Final	29.5
Replication	R3	Rel. Hum. (%)	Initial:	90.0
Duration (hr):	1.00		Final	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	27	J3	4	M3	
A4		D4	4	G4	61	J4	46	M4	
A5		D5	14	G5	74	J5	58	M5	
A6		D6	35	G6	118	J6	42	M6	9
A7		D7	44	G7	124	J7	69	M7	14
► A8		D8	6	G8	37	J8	51	M8	11
A9		D9	28	G9	119	J9	43	M9	7
A10		D10	18	G10	71	J10	38	M10	6
A11		D11	8	G11	48	J11	51	M11	
A12		D12		G12	22	J12	14	M12	
A13		D13		G13		J13	7	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	32	K3		N3	
B4		E4	14	H4	78	K4	16	N4	
B5		E5	42	H5	73	K5	54	N5	
B6		E6	49	H6	145	K6	58	N6	
B7		E7	77	H7	86	K7	39	N7	
B8		E8	14	○ H8		K8	45	N8	
B9		E9	82	H9	94	K9	57	N9	
B10		E10	43	H10	83	K10	41	N10	
B11		E11	56	H11	58	K11	24	N11	
B12		E12		H12	41	K12	9	N12	
B13		E13		H13	7	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	9	I3	20	L3		O3	
C4		F4	43	I4	68	L4	4	O4	
C5		F5	52	I5	69	L5	16	O5	
C6	8	F6	68	I6	84	L6	41	O6	
C7	5	F7	141	I7	138	L7	32	O7	
C8		F8	19	I8	151	L8	48	O8	
C9	12	F9	129	I9	82	L9	34	O9	
C10		F10	76	I10	74	L10	19	O10	
C11		F11	48	I11	39	L11	14	O11	
C12		F12	11	I12	37	L12		O12	
C13		F13		I13	12	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(25): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	2.50		Final	28.5
Replication	R1	Rel. Hum. (%)	Initial	92.0
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	5	J2		M2	
A3		D3		G3	30	J3	22	M3	
A4		D4	8	G4	46	J4	41	M4	
A5		D5	25	G5	59	J5	54	M5	8
A6		D6	30	G6	125	J6	58	M6	18
A7		D7	7	G7	174	J7	90	M7	20
► A8		D8	50	G8	152	J8	74	M8	21
A9		D9	37	G9	128	J9	49	M9	17
A10		D10	18	G10	79	J10	38	M10	11
A11		D11	5	G11	49	J11	36	M11	4
A12		D12		G12	26	J12	20	M12	
A13		D13		G13	8	J13	7	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	8	K2		N2	
B3		E3	7	H3	38	K3	9	N3	
B4		E4	24	H4	56	K4	29	N4	
B5		E5	43	H5	76	K5	44	N5	
B6		E6	49	H6	135	K6	47	N6	
B7		E7	40	H7	119	K7	42	N7	5
B8		E8	77	☼ H8		K8	38	N8	6
B9		E9	78	H9	127	K9	41	N9	4
B10		E10	48	H10	86	K10	18	N10	
B11		E11	30	H11	45	K11	27	N11	
B12		E12	6	H12	31	K12	14	N12	
B13		E13		H13	10	K13	4	N13	
B14		E14		H14	4	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	6	L2		O2	
C3		F3	19	I3	36	L3		O3	
C4		F4	39	I4	52	L4	13	O4	
C5	5	F5	57	I5	63	L5	26	O5	
C6	4	F6	75	I6	95	L6	35	O6	
C7		F7	150	I7	129	L7	36	O7	
C8	27	F8	161	I8	129	L8	35	O8	
C9	9	F9	97	I9	97	L9	25	O9	
C10		F10	62	I10	60	L10	26	O10	
C11		F11	44	I11	44	L11	16	O11	
C12		F12	18	I12	27	L12	4	O12	
C13		F13		I13	11	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(26): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp. (°C)	Initial	29.5
Pressure (kg/cm²)	2.50		Final	28.5
Replication	R2	Rel. Hum. (%)	Initial	88.5
Duration (hr)	1.00		Final	87.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	6	J2		M2	
A3		D3		G3	30	J3	20	M3	
A4		D4	7	G4	45	J4	44	M4	
A5		D5	21	G5	61	J5	56	M5	9
A6		D6	32	G6	128	J6	55	M6	17
A7		D7	8	G7	169	J7	87	M7	20
► A8		D8	54	G8	150	J8	76	M8	27
A9		D9	36	G9	120	J9	46	M9	18
A10		D10	19	G10	82	J10	35	M10	12
A11		D11	5	G11	44	J11	19	M11	5
A12		D12		G12	22	J12	18	M12	
A13		D13		G13	10	J13	9	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	9	K2		N2	
B3		E3	10	H3	39	K3	9	N3	
B4		E4	23	H4	54	K4	30	N4	
B5		E5	46	H5	72	K5	42	N5	
B6		E6	51	H6	139	K6	49	N6	
B7		E7	39	H7	113	K7	41	N7	[illegible]
B8		E8	81	☼ H8		K8	36	N8	[illegible]
B9		E9	75	H9	131	K9	44	N9	6
B10		E10	43	H10	83	K10	40	N10	
B11		E11	31	H11	47	K11	24	N11	
B12		E12	10	H12	30	K12	14	N12	
B13		E13		H13	12	K13	5	N13	
B14		E14		H14	6	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	5	L2		O2	
C3		F3	18	I3	37	L3		O3	
C4		F4	41	I4	53	L4	13	O4	
C5	5	F5	56	I5	66	L5	27	O5	
C6	4	F6	79	I6	93	L6	36	O6	
C7		F7	145	I7	122	L7	34	O7	
C8	23	F8	168	I8	134	L8	32	O8	
C9	11	F9	98	I9	95	L9	23	O9	
C10		F10	60	I10	56	L10	25	O10	
C11		F11	46	I11	46	L11	18	O11	
C12		F12	16	I12	24	L12	6	O12	
C13		F13		I13	13	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(27): Catch-can data (Amount of water obtained in catch-cans)

Emitter	ALRD	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	2.50		Final	28.0
Replication	R3	Rel. Hum. (%)	Initial	90.5
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	7	J2		M2	
A3		D3		G3	29	J3	18	M3	
A4		D4	6	G4	44	J4	46	M4	
A5		D5	21	G5	61	J5	58	M5	9
A6		D6	34	G6	131	J6	52	M6	16
A7		D7	9	G7	164	J7	84	M7	19
► A8		D8	57	G8	148	J8	77	M8	22
A9		D9	34	G9	112	J9	42	M9	18
A10		D10	39	G10	84	J10	32	M10	13
A11		D11	4	G11	39	J11	42	M11	6
A12		D12		G12	18	J12	16	M12	
A13		D13		G13	12	J13	11	M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	9	K2		N2	
B3		E3	12	H3	39	K3	8	N3	
B4		E4	21	H4	51	K4	31	N4	
B5		E5	48	H5	68	K5	40	N5	
B6		E6	52	H6	142	K6	51	N6	
B7		E7	38	H7	106	K7	39	N7	4
B8		E8	84	☼ H8		K8	34	N8	12
B9		E9	72	H9	134	K9	46	N9	8
B10		E10	38	H10	79	K10	41	N10	
B11		E11	32	H11	48	K11	21	N11	
B12		E12	11	H12	29	K12	14	N12	
B13		E13		H13	13	K13	5	N13	
B14		E14		H14	8	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	4	L2		O2	
C3		F3	16	I3	37	L3		O3	
C4		F4	42	I4	54	L4	12	O4	
C5	4	F5	54	I5	68	L5	28	O5	
C6	4	F6	82	I6	91	L6	37	O6	
C7		F7	140	I7	114	L7	32	O7	
C8	18	F8	174	I8	138	L8	28	O8	
C9	13	F9	99	I9	92	L9	21	O9	
C10		F10	57	I10	51	L10	24	O10	
C11		F11	48	I11	47	L11	19	O11	
C12		F12	13	I12	21	L12	7	O12	
C13		F13		I13	14	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, A↑ denotes direction of the frame of the emitter towards that point)

Appendix IV(28): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNBK	Temp. (°C)	Initial	29.5
Pressure (kg/cm²)	1.00		Final	28.0
Replication	R1	Rel. Hum. (%)	Initial	87.0
Duration (hr)	1.00		Final	88.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	6	J3		M3	
A4		D4		G4	8	J4		M4	
A5		D5	4	G5	8	J5		M5	
A6		D6	8	G6	6	J6	5	M6	
A7		D7	7	G7	13	J7	26	M7	
► A8		D8		G8	40	J8	37	M8	
A9		D9	13	G9	39	J9	27	M9	
A10		D10		G10	11	J10	8	M10	
A11		D11		G11	4	J11		M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4	4	H4	8	K4		N4	
B5		E5	10	H5	8	K5		N5	
B6		E6	13	H6	16	K6		N6	
B7		E7	16	H7	73	K7	27	N7	
B8		E8		☼ H8		K8	57	N8	
B9		E9	26	H9	95	K9		N9	
B10		E10		H10	39	K10		N10	
B11		E11		H11	16	K11		N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3		L3		O3	
C4		F4	11	I4	4	L4		O4	
C5		F5	12	I5	7	L5		O5	
C6	4	F6	14	I6	12	L6		O6	
C7	4	F7	17	I7	47	L7	4	O7	
C8		F8	12	I8	76	L8	6	O8	
C9	7	F9	37	I9	47	L9		O9	
C10		F10	4	I10	30	L10		O10	
C11		F11		I11	4	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(29): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNBK | Temp. (°C) Initial 27.0, Final 27.5
Pressure (kg/cm²): 1.00
Replication: R2 | Rel. Hum. (%) Initial 91.0, Final 91.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3		M3	
A4		D4		G4	7	J4		M4	
A5		D5	4	G5	6	J5		M5	
A6		D6	6	G6	9	J6	4	M6	
A7		D7	5	G7	11	J7	28	M7	
► A8		D8		G8	52	J8	39	M8	
A9		D9	8	G9	33	J9	17	M9	
A10		D10		G10	15	J10	7	M10	
A11		D11		G11	5	J11		M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4	4	H4	5	K4		N4	
B5		E5	11	H5	7	K5		N5	
B6		E6	10	H6	18	K6		N6	
B7		E7	18	H7	85	K7	24	N7	
B8		E8	5	☼ H8		K8	15	N8	
B9		E9	22	H9	104	K9		N9	
B10		E10		H10	33	K10		N10	
B11		E11		H11	7	K11		N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	4	I3		L3		O3	
C4		F4	7	I4	4	L4		O4	
C5		F5	11	I5	8	L5		O5	
C6	4	F6	17	I6	13	L6		O6	
C7		F7	13	I7	54	L7	4	O7	
C8	4	F8	10	I8	82	L8	4	O8	
C9	5	F9	41	I9	39	L9		O9	
C10		F10	9	I10	28	L10		O10	
C11		F11		I11	5	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(30): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNBK | Temp. (°C) Initial 28.0, Final 28.0
Pressure (kg/cm²): 1.00
Replication: R3 | Rel. Hum. (%) Initial 90.5, Final 90.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	5	J3		M3	
A4		D4		G4	8	J4		M4	
A5		D5	4	G5	4	J5		M5	
A6		D6	6	G6	7	J6	4	M6	
A7		D7	5	G7	14	J7	32	M7	
► A8		D8	4	G8	64	J8	46	M8	
A9		D9	4	G9	27	J9	14	M9	
A10		D10		G10	13	J10	6	M10	
A11		D11		G11	4	J11		M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5	7	H5	6	K5		N5	
B6		E6	11	H6	19	K6		N6	
B7		E7	22	H7	94	K7	21	N7	
B8		E8	4	☼ H8		K8	13	N8	
B9		E9	16	H9	82	K9		N9	
B10		E10	4	H10	37	K10		N10	
B11		E11		H11	4	K11		N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	4	I3		L3		O3	
C4		F4	6	I4	4	L4		O4	
C5		F5	9	I5	6	L5		O5	
C6		F6	21	I6	12	L6		O6	
C7	4	F7	12	I7	56	L7	4	O7	
C8	4	F8	7	I8	94	L8	4	O8	
C9	5	F9	52	I9	43	L9		O9	
C10	4	F10	12	I10	24	L10		O10	
C11		F11		I11	4	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(31): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNBK | Temp. (°C) Initial 27.0, Final 27.5
Pressure (kg/cm²): 1.50
Replication: R1 | Rel. Hum. (%) Initial 92.5, Final 91.5
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3		M3	
A4		D4		G4	13	J4		M4	
A5		D5	6	G5	10	J5	5	M5	
A6		D6	11	G6	12	J6	10	M6	
A7		D7	10	G7	30	J7	32	M7	
► A8		D8		G8	71	J8	68	M8	
A9		D9	26	G9	42	J9	32	M9	
A10		D10		G10	23	J10	5	M10	
A11		D11		G11	16	J11		M11	
A12		D12		G12	6	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4	7	H4	12	K4		N4	
B5		E5	10	H5	14	K5		N5	
B6		E6	12	H6	32	K6		N6	
B7		E7	12	H7	55	K7	17	N7	
B8		E8		☼ H8		K8	60	N8	
B9		E9	35	H9	93	K9		N9	
B10		E10	7	H10	52	K10		N10	
B11		E11		H11	28	K11		N11	
B12		E12		H12		K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3		L3		O3	
C4		F4	12	I4	7	L4		O4	
C5		F5	13	I5	11	L5		O5	
C6	4	F6	15	I6	18	L6		O6	
C7	5	F7	23	I7	62	L7		O7	
C8		F8	16	I8	110	L8	15	O8	
C9	16	F9	25	I9	55	L9		O9	
C10		F10	5	I10	44	L10		O10	
C11		F11	4	I11	8	L11		O11	
C12		F12	4	I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(32): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNBK | Temp. (°C) Initial 28.0, Final 29.0
Pressure (kg/cm²): 1.50
Replication: R2 | Rel. Hum. (%) Initial 90.0, Final 89.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	6	J3		M3	
A4		D4		G4	12	J4		M4	
A5		D5	5	G5	11	J5	4	M5	
A6		D6	12	G6	9	J6	6	M6	
A7		D7	9	G7	38	J7	28	M7	
► A8		D8		G8	69	J8	76	M8	
A9		D9	24	G9	51	J9	33	M9	
A10		D10		G10	28	J10	8	M10	
A11		D11		G11	14	J11		M11	
A12		D12		G12	5	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4	8	H4	11	K4		N4	
B5		E5	12	H5	16	K5		N5	
B6		E6	10	H6	33	K6		N6	
B7		E7	7	H7	42	K7	24	N7	
B8		E8		☼ H8		K8	75	N8	
B9		E9	42	H9	102	K9		N9	
B10		E10	8	H10	68	K10		N10	
B11		E11		H11	34	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	6	I3		L3		O3	
C4		F4	14	I4	5	L4		O4	
C5		F5	14	I5	12	L5		O5	
C6	4	F6	17	I6	13	L6		O6	
C7	4	F7	28	I7	54	L7		O7	
C8		F8	19	I8	124	L8	18	O8	
C9	13	F9	22	I9	67	L9		O9	
C10		F10	7	I10	38	L10		O10	
C11		F11	4	I11	7	L11		O11	
C12		F12	5	I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(33): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBK	Temp. (°C)	Initial:	26.5
Pressure (kg/cm²)	1.50		Final:	27.0
Replication:	R3	Rel. Hum. (%)	Initial:	92.0
Duration (hr):	1.00		Final:	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	5	J3		M3	
A4		D4		G4	9	J4		M4	
A5		D5	4	G5	14	J5	5	M5	
A6		D6	9	G6	12	J6	4	M6	
A7		D7	4	G7	44	J7	17	M7	
▶ A8		D8		G8	57	J8	84	M8	
A9		D9	21	G9	48	J9	38	M9	
A10		D10		G10	34	J10	5	M10	
A11		D11		G11	12	J11		M11	
A12		D12		G12	7	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	5	K3		N3	
B4		E4	7	H4	14	K4		N4	
B5		E5	9	H5	17	K5		N5	
B6		E6	6	H6	35	K6		N6	
B7		E7	5	H7	64	K7	27	N7	
B8		E8		☼ H8		K8	68	N8	
B9		E9	35	H9	124	K9		N9	
B10		E10	7	H10	77	K10		N10	
B11		E11		H11	28	K11		N11	
B12		E12		H12	7	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	7	I3		L3		O3	
C4		F4	16	I4	4	L4		O4	
C5		F5	14	I5	11	L5		O5	
C6	4	F6	12	I6	15	L6		O6	
C7		F7	22	I7	49	L7		O7	
C8	4	F8	23	I8	118	L8	9	O8	
C9	11	F9	17	I9	52	L9		O9	
C10		F10	5	I10	39	L10		O10	
C11		F11	6	I11	8	L11		O11	
C12		F12	4	I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(34): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBK	Temp. (°C)	Initial:	27.0
Pressure (kg/cm²):	2.00		Final:	28.5
Replication:	R1	Rel. Hum. (%)	Initial:	92.0
Duration (hr):	1.00		Final:	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3		M3	
A4		D4		G4	10	J4		M4	
A5		D5	7	G5	12	J5	4	M5	
A6		D6	8	G6	15	J6	9	M6	
A7		D7	10	G7	36	J7	25	M7	
▶ A8		D8		G8	75	J8	45	M8	5
A9		D9	37	G9	48	J9	48	M9	
A10		D10		G10	21	J10	12	M10	
A11		D11		G11	12	J11		M11	
A12		D12		G12	6	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	4	H3	4	K3		N3	
B4		E4	6	H4	11	K4		N4	
B5		E5	8	H5	17	K5		N5	
B6		E6	13	H6	38	K6	4	N6	
B7		E7	16	H7	72	K7	17	N7	
B8		E8		☼ H8		K8	29	N8	
B9		E9	39	H9	113	K9	7	N9	
B10		E10		H10	40	K10		N10	
B11		E11	4	H11	27	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3	4	L3		O3	
C4		F4	9	I4	4	L4		O4	
C5		F5	13	I5	7	L5		O5	
C6	4	F6	19	I6	18	L6		O6	
C7	5	F7	34	I7	55	L7	12	O7	
C8		F8	18	I8	99	L8	16	O8	
C9	10	F9	42	I9	58	L9		O9	
C10		F10	5	I10	39	L10		O10	
C11		F11	4	I11	31	L11		O11	
C12		F12		I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(35): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNBK	Temp. (°C)	Initial.	28.0
Pressure (kg/cm²)	2.00		Final:	28.5
Replication	R2	Rel. Hum. (%)	Initial	89.5
Duration (hr)	1.00		Final:	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	5	J3		M3	
A4		D4		G4	11	J4		M4	
A5		D5	4	G5	9	J5	5	M5	
A6		D6	9	G6	19	J6	8	M6	
A7		D7	6	G7	31	J7	27	M7	4
▶ A8		D8		G8	84	J8	39	M8	9
A9		D9	44	G9	39	J9	52	M9	
A10		D10		G10	24	J10	18	M10	
A11		D11		G11	16	J11		M11	
A12		D12		G12	5	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	5	H3	4	K3		N3	
B4		E4	4	H4	9	K4		N4	
B5		E5	7	H5	13	K5		N5	
B6		E6	18	H6	41	K6	4	N6	
B7		E7	14	H7	65	K7	19	N7	
B8		E8		☼ H8		K8	24	N8	
B9		E9	54	H9	128	K9	5	N9	
B10		E10	9	H10	35	K10		N10	
B11		E11	4	H11	31	K11		N11	
B12		E12		H12	7	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	6	I3	5	L3		O3	
C4		F4	7	I4	4	L4		O4	
C5		F5	18	I5	10	L5		O5	
C6	5	F6	21	I6	14	L6		O6	
C7	6	F7	28	I7	64	L7	13	O7	
C8		F8	22	I8	87	L8	14	O8	
C9	10	F9	58	I9	56	L9		O9	
C10		F10	9	I10	44	L10		O10	
C11		F11	7	I11	28	L11		O11	
C12		F12		I12	6	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(36): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBK	Temp. (°C)	Initial	30.0
Pressure (kg/cm²):	2.00		Final	29.0
Replication:	R3	Rel. Hum. (%)	Initial:	87.5
Duration (hr):	1.00		Final	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3		M3	
A4		D4		G4	9	J4		M4	
A5		D5	4	G5	12	J5	4	M5	
A6		D6	7	G6	21	J6	7	M6	
A7		D7	4	G7	38	J7	34	M7	7
▶ A8		D8		G8	68	J8	37	M8	6
A9		D9	31	G9	45	J9	64	M9	
A10		D10		G10	27	J10	12	M10	
A11		D11		G11	14	J11		M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	4	H3	5	K3		N3	
B4		E4	6	H4	7	K4		N4	
B5		E5	9	H5	11	K5		N5	
B6		E6	14	H6	45	K6	5	N6	
B7		E7	11	H7	63	K7	21	N7	
B8		E8	8	☼ H8		K8	18	N8	
B9		E9	62	H9	132	K9	7	N9	
B10		E10	7	H10	41	K10		N10	
B11		E11	4	H11	28	K11		N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3	4	L3		O3	
C4		F4	4	I4	4	L4		O4	
C5		F5	12	I5	11	L5		O5	
C6	5	F6	20	I6	12	L6		O6	
C7	4	F7	32	I7	75	L7	24	O7	
C8		F8	27	I8	92	L8	18	O8	
C9	8	F9	69	I9	49	L9		O9	
C10		F10	10	I10	37	L10		O10	
C11		F11	5	I11	31	L11		O11	
C12		F12		I12	7	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(37): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNGR | Temp (°C) Initial: 29.0 | Final: 28.0
Pressure (kg/cm²): 1.00
Replication: R1 | Rel. Hum. (%) Initial: 87.5 | Final: 89.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	4	J4	8	M4	
A5		D5		G5	13	J5	18	M5	
A6		D6		G6	34	J6	15	M6	4
A7		D7		G7	49	J7	16	M7	5
► A8		D8		G8	78	J8	11	M8	
A9		D9		G9	41	J9	14	M9	
A10		D10		G10	7	J10	36	M10	
A11		D11		G11		J11	8	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	14	K4	6	N4	
B5		E5		H5	27	K5	17	N5	
B6		E6		H6	30	K6	16	N6	
B7		E7	8	H7	26	K7	10	N7	
B8		E8	4	☼ H8		K8	6	N8	
B9		E9		H9	75	K9	4	N9	
B10		E10		H10	13	K10	4	N10	
B11		E11		H11	15	K11		N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	5	L3		O3	
C4		F4		I4	17	L4		O4	
C5		F5		I5	20	L5	6	O5	
C6		F6		I6	17	L6	13	O6	
C7		F7	12	I7	15	L7	9	O7	
C8		F8	20	I8	38	L8	4	O8	
C9		F9	23	I9	73	L9		O9	
C10		F10		I10	64	L10		O10	
C11		F11		I11	31	L11		O11	
C12		F12		I12	10	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(38): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNGR | Temp (°C) Initial: 28.0 | Final: 29.5
Pressure (kg/cm²): 1.00
Replication: R2 | Rel. Hum. (%) Initial: 91.0 | Final: 90.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4	6	M4	
A5		D5		G5	17	J5	21	M5	
A6		D6		G6	41	J6	18	M6	5
A7		D7		G7	54	J7	12	M7	4
► A8		D8		G8	76	J8	8	M8	
A9		D9		G9	37	J9	13	M9	
A10		D10		G10	9	J10	31	M10	
A11		D11		G11		J11	13	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	13	K4	9	N4	
B5		E5		H5	28	K5	14	N5	
B6		E6		H6	34	K6	13	N6	
B7		E7	7	H7	25	K7	12	N7	
B8		E8	5	☼ H8		K8	7	N8	
B9		E9		H9	84	K9	4	N9	
B10		E10		H10	17	K10	5	N10	
B11		E11		H11	13	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	4	L3		O3	
C4		F4		I4	15	L4		O4	
C5		F5		I5	21	L5	7	O5	
C6		F6		I6	16	L6	14	O6	
C7		F7	10	I7	21	L7	7	O7	
C8		F8	22	I8	42	L8	5	O8	
C9		F9	17	I9	86	L9		O9	
C10		F10		I10	39	L10		O10	
C11		F11		I11	28	L11		O11	
C12		F12		I12	12	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(39): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNGR | Temp (°C) Initial: 26.5 | Final: 27.5
Pressure (kg/cm²): 1.00
Replication: R3 | Rel. Hum. (%) Initial: 92.0 | Final: 91.5
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	6	J4	4	M4	
A5		D5		G5	15	J5	13	M5	
A6		D6		G6	44	J6	22	M6	4
A7		D7		G7	51	J7	10	M7	4
► A8		D8		G8	82	J8	6	M8	
A9		D9		G9	34	J9	14	M9	
A10		D10		G10	6	J10	36	M10	
A11		D11		G11		J11	17	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	5	K4	7	N4	
B5		E5		H5	18	K5	16	N5	
B6		E6		H6	41	K6	11	N6	
B7		E7	5	H7	28	K7	14	N7	
B8		E8	4	☼ H8		K8	11	N8	
B9		E9		H9	91	K9	7	N9	
B10		E10		H10	19	K10	4	N10	
B11		E11		H11	12	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	4	L3		O3	
C4		F4		I4	18	L4		O4	
C5		F5		I5	20	L5	5	O5	
C6		F6		I6	14	L6	12	O6	
C7		F7	9	I7	18	L7	9	O7	
C8		F8	18	I8	44	L8	4	O8	
C9		F9	14	I9	79	L9		O9	
C10		F10		I10	54	L10		O10	
C11		F11		I11	31	L11		O11	
C12		F12		I12	11	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(40): Catch-can data (Amount of water obtained in catch-cans)

Emitter: JNGR | Temp (°C) Initial: 27.0 | Final: 27.5
Pressure (kg/cm²): 1.50
Replication: R1 | Rel. Hum. (%) Initial: 92.0 | Final: 92.0
Duration (hr): 1.00
Wind Data: No wind (closed indoors)

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	9	J4	8	M4	
A5		D5		G5	20	J5	14	M5	
A6		D6		G6	52	J6	17	M6	4
A7		D7		G7	61	J7	20	M7	7
► A8		D8		G8	128	J8	17	M8	
A9		D9		G9	62	J9	18	M9	
A10		D10		G10	24	J10	46	M10	
A11		D11		G11		J11	15	M11	
A12		D12		G12		J12	5	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	7	K3		N3	
B4		E4		H4	12	K4	4	N4	
B5		E5		H5	20	K5	13	N5	
B6		E6		H6	37	K6	14	N6	
B7		E7	10	H7	41	K7	12	N7	
B8		E8	5	☼ H8		K8	6	N8	
B9		E9	6	H9	80	K9	4	N9	
B10		E10		H10	38	K10	6	N10	
B11		E11		H11	10	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	5	L3		O3	
C4		F4		I4	13	L4		O4	
C5		F5	4	I5	15	L5	8	O5	
C6		F6	4	I6	26	L6	12	O6	
C7		F7	12	I7	19	L7	8	O7	
C8		F8	23	I8	50	L8		O8	
C9		F9	24	I9	75	L9		O9	
C10		F10	7	I10	73	L10		O10	
C11		F11		I11	16	L11		O11	
C12		F12		I12	17	L12		O12	
C13		F13		I13	4	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(41): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNGR	Temp (°C)	Initial	29.5
Pressure (kg/cm²)	1.50		Final	28.5
Replication	R2	Rel. Hum (%)	Initial	88.0
Duration (hr)	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	5	J4	4	M4	
A5		D5		G5	17	J5	13	M5	
A6		D6		G6	48	J6	17	M6	5
A7		D7		G7	59	J7	21	M7	4
► A8		D8		G8	132	J8	19	M8	
A9		D9		G9	64	J9	14	M9	
A10		D10		G10	27	J10	54	M10	
A11		D11		G11		J11	16	M11	
A12		D12		G12		J12	9	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4		H4	13	K4	5	N4	
B5		E5		H5	22	K5	17	N5	
B6		E6		H6	34	K6	15	N6	
B7		E7	7	H7	39	K7	11	N7	
B8		E8	6	○ H8		K8	9	N8	
B9		E9	4	H9	85	K9	5	N9	
B10		E10		H10	39	K10	6	N10	
B11		E11		H11	32	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	6	L3		O3	
C4		F4		I4	12	L4		O4	
C5		F5	4	I5	20	L5	4	O5	
C6		F6	5	I6	25	L6	14	O6	
C7		F7	10	I7	17	L7	7	O7	
C8		F8	21	I8	43	L8		O8	
C9		F9	27	I9	82	L9		O9	
C10		F10	8	I10	70	L10		O10	
C11		F11		I11	18	L11		O11	
C12		F12		I12	12	L12		O12	
C13		F13		I13	7	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: A20 denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(42): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNGR	Temp (°C)	Initial	28.0
Pressure (kg/cm²)	1.50		Final	29.0
Replication	R3	Rel. Hum (%)	Initial	90.5
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	4	J4	4	M4	
A5		D5		G5	18	J5	10	M5	
A6		D6		G6	44	J6	18	M6	5
A7		D7		G7	51	J7	22	M7	6
► A8		D8		G8	112	J8	18	M8	
A9		D9		G9	67	J9	12	M9	
A10		D10		G10	23	J10	51	M10	
A11		D11		G11		J11	14	M11	
A12		D12		G12		J12	8	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	7	K3		N3	
B4		E4		H4	11	K4	6	N4	
B5		E5		H5	18	K5	14	N5	
B6		E6		H6	35	K6	18	N6	
B7		E7	5	H7	43	K7	10	N7	
B8		E8	4	○ H8		K8	8	N8	
B9		E9	4	H9	78	K9	4	N9	
B10		E10		H10	42	K10	4	N10	
B11		E11		H11	10	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13	4	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	7	L3		O3	
C4		F4		I4	11	L4		O4	
C5		F5	5	I5	21	L5	5	O5	
C6		F6	4	I6	24	L6	11	O6	
C7		F7	12	I7	15	L7	8	O7	
C8		F8	19	I8	38	L8		O8	
C9		F9	24	I9	77	L9		O9	
C10		F10	6	I10	68	L10		O10	
C11		F11		I11	19	L11		O11	
C12		F12		I12	13	L12		O12	
C13		F13		I13	4	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(43): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNGR	Temp. (°C)	Initial	28.5
Pressure (kg/cm²)	2.00		Final	29.5
Replication	R1	Rel. Hum (%)	Initial.	90.0
Duration (hr)	1.00		Final.	88.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4	5	M4	
A5		D5		G5	13	J5	10	M5	
A6		D6		G6	38	J6	19	M6	
A7		D7		G7	58	J7	18	M7	
► A8		D8		G8	114	J8	16	M8	9
A9		D9		G9	52	J9	15	M9	
A10		D10		G10	37	J10	24	M10	
A11		D11		G11	4	J11	16	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4		H4	13	K4		N4	
B5		E5		H5	27	K5	5	N5	
B6		E6		H6	47	K6	14	N6	
B7		E7	12	H7	81	K7	15	N7	
B8		E8	5	○ H8		K8	6	N8	4
B9		E9	10	H9	75	K9	5	N9	
B10		E10		H10	39	K10	5	N10	
B11		E11		H11	8	K11		N11	
B12		E12		H12	7	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	7	L4		O4	
C5		F5		I5	15	L5		O5	
C6		F6		I6	28	L6	8	O6	
C7		F7	8	I7	38	L7	12	O7	
C8		F8	26	I8	47	L8	8	O8	
C9		F9	28	I9	86	L9		O9	
C10		F10	7	I10	74	L10		O10	
C11		F11		I11	24	L11		O11	
C12		F12		I12	17	L12		O12	
C13		F13		I13	4	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(44): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNGR	Temp (°C)	Initial	26.5
Pressure (kg/cm²)	2.00		Final	27.0
Replication	R2	Rel. Hum (%)	Initial	92.0
Duration (hr).	1.00		Final	92.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4	7	M4	
A5		D5		G5	14	J5	11	M5	
A6		D6		G6	29	J6	8	M6	
A7		D7		G7	64	J7	21	M7	
► A8		D8		G8	132	J8	17	M8	[illegible]
A9		D9		G9	61	J9	14	M9	
A10		D10		G10	39	J10	21	M10	
A11		D11		G11	7	J11	12	M11	
A12		D12		G12		J12	7	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	5	K3		N3	
B4		E4		H4	12	K4		N4	
B5		E5		H5	31	K5	4	N5	
B6		E6		H6	48	K6	13	N6	
B7		E7	9	H7	84	K7	18	N7	
B8		E8	4	○ H8		K8	9	N8	5
B9		E9	8	H9	72	K9	5	N9	
B10		E10		H10	43	K10	4	N10	
B11		E11		H11	9	K11		N11	
B12		E12		H12	6	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	8	L4		O4	
C5		F5		I5	13	L5		O5	
C6		F6		I6	31	L6	7	O6	
C7		F7	7	I7	37	L7	13	O7	
C8		F8	21	I8	44	L8	4	O8	
C9		F9	32	I9	92	L9		O9	
C10		F10	9	I10	69	L10		O10	
C11		F11		I11	23	L11		O11	
C12		F12		I12	19	L12		O12	
C13		F13		I13	5	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(45): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNGR	Temp (°C)	Initial:	27.5
Pressure (kg/cm^2)	2.00		Final:	28.5
Replication	R1	Rel. Hum. (%)	Initial:	91.0
Duration (hr)	1.00		Final:	90.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4	6	M4	
A5		D5		G5	11	J5	12	M5	
A6		D6		G6	27	J6	15	M6	
A7		D7		G7	67	J7	24	M7	
► A8		D8		G8	12[illegible]	J8	18	M8	5
A9		D9		G9	57	J9	16	M9	
A10		D10		G10	36	J10	19	M10	
A11		D11		G11	9	J11	9	M11	
A12		D12		G12		J12	5	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4		H4	11	K4		N4	
B5		E5		H5	28	K5	5	N5	
B6		E6		H6	45	K6	12	N6	
B7		E7	5	H7	76	K7	16	N7	
B8		E8	6	◻ H8		K8	7	N8	4
B9		E9	10	H9	71	K9	7	N9	
B10		E10		H10	44	K10	5	N10	
B11		E11		H11	14	K11		N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	7	L4		O4	
C5		F5		I5	15	L5		O5	
C6		F6		I6	29	L6	9	O6	
C7		F7	4	I7	38	L7	12	O7	
C8		F8	17	I8	51	L8	4	O8	
C9		F9	29	I9	88	L9		O9	
C10		F10	8	I10	72	L10		O10	
C11		F11		I11	25	L11		O11	
C12		F12		I12	17	L12		O12	
C13		F13		I13	6	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, A13 denotes direction of the frame of the emitter towards that point)

Appendix IV(46): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNWH	Temp. (°C)	Initial:	28.5
Pressure (kg/cm^2):	1.00		Final:	29.5
Replication:	R1	Rel. Hum. (%)	Initial:	88.5
Duration (hr):	1.00		Final:	88.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	11	J5	10	M5	
A6		D6		G6	28	J6	20	M6	
A7		D7		G7	57	J7	26	M7	
► A8		D8	4	G8	56	J8	37	M8	
A9		D9		G9	50	J9	48	M9	
A10		D10		G10	33	J10	16	M10	
A11		D11		G11	15	J11	7	M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	15	K5	4	N5	
B6		E6	4	H6	30	K6	10	N6	
B7		E7	33	H7	75	K7	16	N7	
B8		E8	47	◻ H8		K8	18	N8	
B9		E9	20	H9	52	K9	15	N9	
B10		E10	6	H10	29	K10	6	N10	
B11		E11		H11	21	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	4	L4		O4	
C5		F5	5	I5	13	L5		O5	
C6		F6	13	I6	25	L6		O6	
C7		F7	62	I7	57	L7		O7	
C8		F8	34	I8	74	L8	5	O8	
C9		F9	35	I9	60	L9	4	O9	
C10		F10	37	I10	33	L10		O10	
C11		F11	7	I11	16	L11		O11	
C12		F12		I12		L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(47): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNWH	Temp (°C)	Initial	26.0
Pressure (kg/cm^2)	1.00		Final	26.5
Replication	R2	Rel. Hum. (%)	Initial:	91.5
Duration (hr)	1.00		Final	90.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	10	J5	8	M5	
A6		D6		G6	27	J6	24	M6	
A7		D7		G7	62	J7	26	M7	
► A8		D8	4	G8	64	J8	39	M8	
A9		D9		G9	48	J9	54	M9	
A10		D10		G10	32	J10	18	M10	
A11		D11		G11	9	J11	6	M11	
A12		D12		G12	5	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	16	K5	4	N5	
B6		E6	1	H6	38	K6	9	N6	
B7		E7	15	H7	85	K7	18	N7	
B8		E8	46	◻ H8		K8	21	N8	
B9		E9	[illegible]	H9	45	K9	16	N9	
B10		E10	[illegible]	H10	26	K10	5	N10	
B11		E11		H11	24	K11		N11	
B12		E12		H12	9	K12		N12	
B13		E13		H13	4	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	4	L4		O4	
C5		F5	4	I5	11	L5		O5	
C6		F6	10	I6	28	L6		O6	
C7		F7	68	I7	61	L7		O7	
C8		F8	17	I8	84	L8	7	O8	
C9		F9	42	I9	72	L9	4	O9	
C10		F10	38	I10	28	L10		O10	
C11		F11	6	I11	14	L11		O11	
C12		F12		I12	5	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(48): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNWH	Temp (°C)	Initial	27.0
Pressure (kg/cm^2):	1.00		Final	28.0
Replication:	R3	Rel. Hum. (%)	Initial	90.5
Duration (hr):	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	9	J5	9	M5	
A6		D6		G6	21	J6	22	M6	
A7		D7		G7	48	J7	23	M7	
► A8		D8	4	G8	64	J8	34	M8	
A9		D9	4	G9	53	J9	52	M9	
A10		D10		G10	18	J10	[illegible]	M10	
A11		D11		G11	9	J11	8	M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	4	K4		N4	
B5		E5		H5	16	K5	4	N5	
B6		E6	4	H6	28	K6	12	N6	
B7		E7	16	H7	64	K7	[illegible]	N7	
B8		E8	32	◻ H8		K8	23	N8	
B9		E9	16	H9	53	K9	12	N9	
B10		E10	4	H10	28	K10	7	N10	
B11		E11		H11	18	K11		N11	
B12		E12		H12	7	K12		N12	
B13		E13		H13	4	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	4	L4		O4	
C5		F5	4	I5	9	L5		O5	
C6		F6	17	I6	20	L6		O6	
C7		F7	54	I7	54	L7		O7	
C8		F8	29	I8	78	L8	7	O8	
C9		F9	37	I9	63	L9	4	O9	
C10		F10	48	I10	28	L10		O10	
C11		F11	12	I11	15	L11		O11	
C12		F12	4	I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(49): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNWH	Temp (°C)	Initial	29.0
Pressure (kg/cm²)	1.50		Final:	28.0
Replication	R1	Rel Hum (%)	Initial:	87.5
Duration (hr)	1.00		Final:	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3		M3	
A4		D4		G4	9	J4	7	M4	
A5		D5		G5	14	J5	14	M5	
A6		D6	4	G6	29	J6	19	M6	
A7		D7		G7	50	J7	34	M7	
► A8		D8	7	G8	87	J8	38	M8	
A9		D9	5	G9	59	J9	36	M9	
A10		D10		G10	38	J10	29	M10	
A11		D11		G11	24	J11	13	M11	
A12		D12		G12	5	J12	5	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	7	K3		N3	
B4		E4		H4	10	K4	4	N4	
B5		E5	5	H5	17	K5	8	N5	
B6		E6	16	H6	28	K6	13	N6	
B7		E7	47	H7	83	K7	18	N7	
B8		E8	33	☐ H8		K8	21	N8	
B9		E9	24	H9	97	K9	16	N9	
B10		E10	14	H10	42	K10	9	N10	
B11		E11	5	H11	25	K11	8	N11	
B12		E12		H12	9	K12	4	N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	5	L3		O3	
C4		F4	6	I4	13	L4		O4	
C5		F5	10	I5	15	L5	4	O5	
C6		F6	20	I6	29	L6	5	O6	
C7		F7	56	I7	60	L7	8	O7	
C8		F8	45	I8	126	L8	7	O8	
C9		F9	42	I9	80	L9	7	O9	
C10		F10	39	I10	35	L10	4	O10	
C11		F11	13	I11	18	L11		O11	
C12		F12		I12	6	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☐ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(50): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNWH	Temp. (°C)	Initial	27.5
Pressure (kg/cm²)	1.50		Final	29.0
Replication	R2	Rel. Hum. (%)	Initial	91.0
Duration (hr)	1.00		Final.	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3		M3	
A4		D4		G4	15	J4	5	M4	
A5		D5		G5	18	J5	9	M5	
A6		D6	5	G6	21	J6	24	M6	
A7		D7	6	G7	54	J7	32	M7	
► A8		D8	4	G8	102	J8	48	M8	
A9		D9		G9	84	J9	33	M9	
A10		D10		G10	22	J10	22	M10	
A11		D11		G11	21	J11	14	M11	
A12		D12		G12	8	J12	8	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	4	K3		N3	
B4		E4		H4	12	K4	5	N4	
B5		E5	4	H5	18	K5	8	N5	
B6		E6	12	H6	29	K6	12	N6	
B7		E7	38	H7	83	K7	25	N7	
B8		E8	34	☐ H8		K8	26	N8	
B9		E9	29	H9	91	K9	18	N9	
B10		E10	21	H10	51	K10	12	N10	
B11		E11	8	H11	24	K11	6	N11	
B12		E12		H12	12	K12	4	N12	
B13		E13		H13	7	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	5	L3		O3	
C4		F4	8	I4	18	L4		O4	
C5		F5	14	I5	14	L5	4	O5	
C6		F6	19	I6	34	L6	4	O6	
C7		F7	44	I7	53	L7	4	O7	
C8		F8	41	I8	184	L8	8	O8	
C9		F9	39	I9	84	L9	5	O9	
C10		F10	44	I10	34	L10	4	O10	
C11		F11	18	I11	22	L11		O11	
C12		F12		I12	7	L12		O12	
C13		F13		I13	4	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☐ denotes emitter, A13 denotes direction of the frame of the emitter towards that point)

Appendix IV(51): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNWH	Temp (°C)	Initial:	26.0
Pressure (kg/cm²)	1.50		Final:	27.0
Replication	R3	Rel Hum (%)	Initial	92.0
Duration (hr)	1.00		Final	92.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3		M3	
A4		D4		G4	10	J4	6	M4	
A5		D5		G5	13	J5	11	M5	
A6		D6	4	G6	28	J6	21	M6	
A7		D7	6	G7	47	J7	31	M7	
► A8		D8		G8	91	J8	42	M8	
A9		D9	5	G9	61	J9	34	M9	
A10		D10		G10	39	J10	27	M10	
A11		D11		G11	27	J11	16	M11	
A12		D12		G12	6	J12	4	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4		H4	10	K4	4	N4	
B5		E5	4	H5	16	K5	7	N5	
B6		E6	11	H6	26	K6	14	N6	
B7		E7	19	H7	78	K7	21	N7	
B8		E8	28	☐ H8		K8	27	N8	
B9		E9	21	H9	90	K9	19	N9	
B10		E10	17	H10	48	K10	10	N10	
B11		E11	6	H11	28	K11	7	N11	
B12		E12		H12	17	K12	4	N12	
B13		E13		H13	5	K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	6	L3		O3	
C4		F4	7	I4	13	L4		O4	
C5		F5	11	I5	17	L5	4	O5	
C6		F6	18	I6	28	L6	4	O6	
C7		F7	43	I7	56	L7	5	O7	
C8		F8	39	I8	128	L8	7	O8	
C9		F9	36	I9	77	L9	6	O9	
C10		F10	34	I10	36	L10	4	O10	
C11		F11	15	I11	21	L11		O11	
C12		F12		I12	8	L12		O12	
C13		F13		I13	4	L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: A42 denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(52): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNWH	Temp (°C)	Initial	27.0
Pressure (kg/cm²).	2.00		Final.	28.0
Replication:	R1	Rel. Hum (%)	Initial	90.0
Duration (hr)	1.00		Final:	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	6	J3		M3	
A4		D4		G4	8	J4	6	M4	
A5		D5		G5	14	J5	11	M5	
A6		D6	7	G6	26	J6	21	M6	
A7		D7	4	G7	55	J7	35	M7	
► A8		D8	7	G8	114	J8	44	M8	
A9		D9		G9	74	J9	37	M9	
A10		D10		G10	41	J10	27	M10	
A11		D11		G11	18	J11	13	M11	
A12		D12		G12		J12	4	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	7	K3		N3	
B4		E4		H4	8	K4		N4	
B5		E5	6	H5	13	K5	7	N5	
B6		E6	11	H6	29	K6	12	N6	
B7		E7	37	H7	83	K7	18	N7	
B8		E8	22	☐ H8		K8	22	N8	
B9		E9	22	H9	108	K9	21	N9	
B10		E10	10	H10	42	K10	17	N10	
B11		E11	4	H11	20	K11	11	N11	
B12		E12		H12	7	K12	5	N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	5	L3		O3	
C4		F4	6	I4	7	L4		O4	
C5		F5	9	I5	15	L5		O5	
C6		F6	22	I6	34	L6	4	O6	
C7		F7	42	I7	73	L7	7	O7	
C8		F8	43	I8	140	L8	7	O8	
C9		F9	46	I9	91	L9	6	O9	
C10		F10	36	I10	31	L10	5	O10	
C11		F11	12	I11	17	L11		O11	
C12		F12		I12	5	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☐ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(53): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNWH	Temp. (°C)	Initial:	26.0
Pressure (kg/cm²)	2.00		Final	26.5
Replication	R2	Rel. Hum. (%)	Initial	91.5
Duration (hr)	1.00		Final	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	6	J3		M3	
A4		D4		G4	7	J4	4	M4	
A5		D5		G5	12	J5	11	M5	
A6		D6	4	G6	29	J6	29	M6	
A7		D7	7	G7	62	J7	42	M7	
► A8		D8	4	G8	108	J8	47	M8	
A9		D9		G9	85	J9	35	M9	
A10		D10		G10	49	J10	31	M10	
A11		D11		G11	21	J11	10	M11	
A12		D12		G12	4	J12	6	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	5	K3		N3	
B4		E4		H4	10	K4		N4	
B5		E5	6	H5	11	K5	4	N5	
B6		E6	12	H6	33	K6	12	N6	
B7		E7	34	H7	86	K7	23	N7	
B8		E8	25	☼ H8		K8	19	N8	
B9		E9	22	H9	126	K9	17	N9	
B10		E10	10	H10	49	K10	16	N10	
B11		E11	4	H11	17	K11	8	N11	
B12		E12		H12	5	K12	5	N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	7	L3		O3	
C4		F4	8	I4	10	L4		O4	
C5		F5	12	I5	14	L5		O5	
C6		F6	27	I6	16	L6	4	O6	
C7		F7	49	I7	71	L7	5	O7	
C8		F8	57	I8	132	L8	8	O8	
C9		F9	41	I9	84	L9	6	O9	
C10		F10	42	I10	37	L10	4	O10	
C11		F11	11	I11	26	L11		O11	
C12		F12		I12	8	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(54): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNWH	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	2.00		Final	28.5
Replication	R3	Rel. Hum. (%)	Initial	90.0
Duration (hr)	1.00		Final	88.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	5	J3		M3	
A4		D4		G4	9	J4	5	M4	
A5		D5		G5	13	J5	12	M5	
A6		D6	6	G6	28	J6	26	M6	
A7		D7	5	G7	64	J7	38	M7	
► A8		D8	4	G8	120	J8	41	M8	
A9		D9		G9	82	J9	36	M9	
A10		D10		G10	40	J10	29	M10	
A11		D11		G11	19	J11	11	M11	
A12		D12		G12		J12	7	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4		H4	9	K4		N4	
B5		E5	5	H5	12	K5	5	N5	
B6		E6	10	H6	31	K6	11	N6	
B7		E7	38	H7	87	K7	21	N7	
B8		E8	21	☼ H8		K8	20	N8	
B9		E9	23	H9	112	K9	19	N9	
B10		E10	9	H10	45	K10	14	N10	
B11		E11	6	H11	18	K11	9	N11	
B12		E12		H12	6	K12	7	N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3	6	L3		O3	
C4		F4	7	I4	9	L4		O4	
C5		F5	11	I5	16	L5		O5	
C6		F6	23	I6	33	L6	5	O6	
C7		F7	47	I7	69	L7	6	O7	
C8		F8	51	I8	127	L8	8	O8	
C9		F9	44	I9	86	L9	7	O9	
C10		F10	38	I10	34	L10	4	O10	
C11		F11	10	I11	21	L11		O11	
C12		F12		I12	7	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(55): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNBL	Temp. (°C)	Initial:	28.0
Pressure (kg/cm²)	1.00		Final	28.0
Replication	R1	Rel. Hum. (%)	Initial	87.0
Duration (hr)	1.00		Final	88.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	4	J1	5	M1	
A2		D2		G2	20	J2	23	M2	5
A3		D3	4	G3	31	J3	20	M3	12
A4		D4	20	G4	22	J4	22	M4	13
A5		D5	23	G5	25	J5	17	M5	10
A6		D6	21	G6	34	J6	12	M6	9
A7		D7	20	G7	51	J7	31	M7	9
► A8		D8		G8	112	J8	63	M8	8
A9		D9	25	G9	73	J9	73	M9	4
A10		D10	22	G10	58	J10	64	M10	
A11		D11	16	G11	39	J11	35	M11	
A12		D12	8	G12	20	J12	8	M12	
A13		D13	5	G13	15	J13		M13	
A14		D14	4	G14	8	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	5	K1		N1	
B2		E2	4	H2	24	K2	20	N2	
B3		E3	21	H3	27	K3	20	N3	
B4		E4	38	H4	22	K4	15	N4	
B5		E5	39	H5	27	K5	10	N5	
B6		E6	36	H6	58	K6	13	N6	
B7		E7	35	H7	108	K7	18	N7	
B8		E8	17	☼ H8		K8	38	N8	
B9	12	E9	36	H9	129	K9	39	N9	
B10	8	E10	23	H10	62	K10	36	N10	
B11	7	E11	18	H11	57	K11	7	N11	
B12		E12	15	H12	32	K12		N12	
B13		E13	18	H13		K13		N13	
B14		E14	6	H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1	6	L1		O1	
C2		F2	14	I2	31	L2	19	O2	
C3		F3	34	I3	25	L3	21	O3	
C4		F4	36	I4	20	L4	13	O4	
C5	7	F5	35	I5	17	L5	10	O5	
C6	13	F6	54	I6	23	L6	15	O6	
C7		F7	18	I7	36	L7	15	O7	
C8		F8	25	I8	87	L8	20	O8	
C9	28	F9	67	I9	138	L9	18	O9	
C10	19	F10	17	I10	101	L10	8	O10	
C11	15	F11	17	I11	44	L11		O11	
C12	5	F12	17	I12	17	L12		O12	
C13		F13	34	I13		L13		O13	
C14		F14	9	I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(56): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp (°C)	Initial	27.0
Pressure (kg/cm²):	1.00		Final	27.5
Replication:	R2	Rel. Hum. (%)	Initial	91.5
Duration (hr):	1.00		Final	91.5
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	5	J1	4	M1	
A2		D2		G2	15	J2	28	M2	7
A3		D3	7	G3	34	J3	24	M3	13
A4		D4	13	G4	21	J4	26	M4	21
A5		D5	21	G5	27	J5	14	M5	8
A6		D6	25	G6	31	J6	11	M6	7
A7		D7	18	G7	48	J7	35	M7	13
► A8		D8		G8	124	J8	68	M8	6
A9		D9	21	G9	82	J9	77	M9	5
A10		D10	24	G10	61	J10	62	M10	
A11		D11	18	G11	35	J11	38	M11	
A12		D12	9	G12	24	J12	7	M12	
A13		D13	4	G13	18	J13		M13	
A14		D14	6	G14	7	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	4	K1		N1	
B2		E2	5	H2	25	K2	13	N2	
B3		E3	17	H3	29	K3	19	N3	
B4		E4	39	H4	21	K4	16	N4	
B5		E5	37	H5	25	K5	9	N5	
B6		E6	31	H6	52	K6	18	N6	
B7		E7	38	H7	113	K7	14	N7	
B8		E8	19	☼ H8		K8	37	N8	
B9	10	E9	32	H9	138	K9	36	N9	
B10	9	E10	27	H10	61	K10	28	N10	
B11	5	E11	19	H11	48	K11	9	N11	
B12		E12	11	H12	29	K12		N12	
B13		E13	12	H13		K13		N13	
B14		E14	7	H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1	7	L1		O1	
C2		F2	12	I2	34	L2	14	O2	
C3		F3	38	I3	29	L3	18	O3	
C4		F4	39	I4	18	L4	17	O4	
C5	4	F5	31	I5	14	L5	12	O5	
C6	12	F6	29	I6	25	L6	13	O6	
C7		F7	41	I7	39	L7	9	O7	
C8		F8	27	I8	80	L8	18	O8	
C9	12	F9	72	I9	128	L9	21	O9	
C10	17	F10	32	I10	99	L10	5	O10	
C11	12	F11	35	I11	58	L11		O11	
C12	4	F12	19	I12	13	L12		O12	
C13		F13	11	I13		L13		O13	
C14		F14	4	I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(57): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial:	29.0
Pressure (kg/cm²):	1.00		Final:	28.0
Replication:	R3	Rel. Hum. (%)	Initial:	88.5
Duration (hr):	1.00		Final:	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	4	J1	4	M1	
A2		D2		G2	17	J2	26	M2	6
A3		D3	4	G3	33	J3	22	M3	13
A4		D4	17	G4	22	J4	24	M4	17
A5		D5	22	G5	26	J5	17	M5	9
A6		D6	23	G6	31	J6	15	M6	8
A7		D7	19	G7	54	J7	33	M7	10
► A8		D8		G8	118	J8	66	M8	7
A9		D9	23	G9	78	J9	75	M9	4
A10		D10	23	G10	59	J10	60	M10	
A11		D11	17	G11	37	J11	37	M11	
A12		D12	9	G12	22	J12	8	M12	
A13		D13	4	G13	14	J13		M13	
A14		D14	5	G14	8	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	4	K1		N1	
B2		E2	4	H2	23	K2	14	N2	
B3		E3	19	H3	28	K3	18	N3	
B4		E4	39	H4	22	K4	16	N4	
B5		E5	38	H5	26	K5	10	N5	
B6		E6	34	H6	55	K6	16	N6	
B7		E7	37	H7	114	K7	16	N7	
B8		E8	18	☼ H8		K8	34	N8	
B9	11	E9	34	H9	135	K9	28	N9	
B10	8	E10	25	H10	62	K10	32	N10	
B11	6	E11	19	H11	53	K11	8	N11	
B12		E12	13	H12	30	K12		N12	
B13		E13	15	H13		K13		N13	
B14		E14	6	H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1	7	L1		O1	
C2		F2	13	I2	32	L2	17	O2	
C3		F3	36	I3	27	L3	19	O3	
C4		F4	37	I4	19	L4	12	O4	
C5	5	F5	33	I5	16	L5	11	O5	
C6	12	F6	31	I6	24	L6	14	O6	
C7		F7	40	I7	38	L7	12	O7	
C8		F8	26	I8	83	L8	19	O8	
C9	30	F9	68	I9	134	L9	21	O9	
C10	18	F10	35	I10	100	L10	7	O10	
C11	13	F11	36	I11	51	L11		O11	
C12	6	F12	18	I12	15	L12		O12	
C13		F13	11	I13		L13		O13	
C14		F14	7	I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(58): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial:	27.5
Pressure (kg/cm²):	1.50		Final:	29.0
Replication:	R1	Rel. Hum. (%)	Initial:	91.0
Duration (hr):	1.00		Final:	89.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	4	J1	7	M1	
A2		D2		G2	14	J2	19	M2	5
A3		D3	9	G3	36	J3	25	M3	12
A4		D4	18	G4	41	J4	26	M4	11
A5		D5	19	G5	45	J5	26	M5	11
A6		D6	21	G6	60	J6	25	M6	10
A7		D7	16	G7	92	J7	38	M7	10
► A8		D8		G8	154	J8	74	M8	12
A9		D9	27	G9	97	J9	94	M9	7
A10	4	D10	21	G10	88	J10	82	M10	5
A11		D11	14	G11	56	J11	47	M11	
A12		D12	8	G12	26	J12	13	M12	
A13		D13	8	G13	15	J13		M13	
A14		D14	8	G14	7	J14		M14	
A15		D15		G15	5	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	6	K1	5	N1	
B2		E2	8	H2	24	K2	15	N2	
B3		E3	19	H3	37	K3	19	N3	4
B4		E4	31	H4	36	K4	20	N4	5
B5	4	E5	37	H5	41	K5	17	N5	6
B6	4	E6	38	H6	75	K6	16	N6	4
B7		E7	41	H7	158	K7	24	N7	5
B8		E8	22	☼ H8		K8	49	N8	5
B9	16	E9	42	H9	168	K9	49	N9	
B10	7	E10	28	H10	79	K10	45	N10	
B11	8	E11	23	H11	70	K11	18	N11	
B12	5	E12	13	H12	39	K12	4	N12	
B13		E13	15	H13	14	K13		N13	
B14		E14	9	H14	5	K14		N14	
B15		E15		H15	4	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	4	I1	8	L1	4	O1	
C2		F2	12	I2	23	L2	10	O2	
C3		F3	25	I3	29	L3	17	O3	
C4	5	F4	37	I4	31	L4	14	O4	
C5	10	F5	40	I5	36	L5	11	O5	
C6	12	F6	51	I6	39	L6	14	O6	
C7	4	F7	57	I7	49	L7	16	O7	
C8		F8	39	I8	96	L8	31	O8	
C9	24	F9	87	I9	162	L9	24	O9	
C10	16	F10	47	I10	130	L10	19	O10	
C11	12	F11	39	I11	63	L11	4	O11	
C12	8	F12	18	I12	26	L12		O12	
C13	4	F13	12	I13	6	L13		O13	
C14		F14	11	I14		L14		O14	
C15		F15	4	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(59): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial:	26.0
Pressure (kg/cm²):	1.50		Final:	26.5
Replication:	R2	Rel. Hum. (%)	Initial:	92.5
Duration (hr):	1.00		Final:	92.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	5	J1	5	M1	
A2		D2		G2	12	J2	17	M2	4
A3		D3	7	G3	42	J3	24	M3	13
A4		D4	14	G4	38	J4	28	M4	10
A5		D5	21	G5	51	J5	24	M5	9
A6		D6	17	G6	59	J6	21	M6	10
A7		D7	13	G7	104	J7	43	M7	8
► A8		D8		G8	172	J8	81	M8	13
A9	4	D9	32	G9	87	J9	92	M9	8
A10		D10	18	G10	94	J10	84	M10	4
A11		D11	16	G11	53	J11	52	M11	
A12		D12	7	G12	28	J12	10	M12	
A13		D13	4	G13	11	J13		M13	
A14		D14	6	G14	6	J14		M14	
A15		D15		G15	4	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	5	K1	6	N1	
B2		E2	9	H2	21	K2	13	N2	
B3		E3	16	H3	38	K3	21	N3	5
B4		E4	34	H4	35	K4	27	N4	6
B5	5	E5	42	H5	39	K5	18	N5	4
B6	4	E6	37	H6	84	K6	19	N6	4
B7		E7	45	H7	151	K7	26	N7	5
B8		E8	18	☼ H8		K8	51	N8	4
B9	14	E9	51	H9	158	K9	47	N9	
B10	6	E10	32	H10	71	K10	49	N10	
B11	5	E11	19	H11	82	K11	14	N11	
B12	4	E12	16	H12	34	K12	5	N12	
B13		E13	12	H13	11	K13		N13	
B14		E14	8	H14	6	K14		N14	
B15		E15		H15	4	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	5	I1	6	L1	4	O1	
C2		F2	14	I2	21	L2	11	O2	
C3		F3	28	I3	32	L3	14	O3	
C4	4	F4	34	I4	37	L4	9	O4	
C5	7	F5	49	I5	34	L5	12	O5	
C6	13	F6	54	I6	41	L6	15	O6	
C7	5	F7	64	I7	48	L7	14	O7	
C8		F8	31	I8	104	L8	34	O8	
C9	20	F9	94	I9	161	L9	23	O9	
C10	13	F10	45	I10	142	L10	18	O10	
C11	11	F11	41	I11	69	L11	5	O11	
C12	9	F12	14	I12	24	L12		O12	
C13	5	F13	9	I13	7	L13		O13	
C14		F14	8	I14		L14		O14	
C15		F15	4	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(60): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial:	28.5
Pressure (kg/cm²):	1.50		Final:	28.0
Replication:	R3	Rel. Hum. (%)	Initial:	88.5
Duration (hr):	1.00		Final:	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	5	J1	6	M1	
A2		D2		G2	13	J2	18	M2	5
A3		D3	8	G3	39	J3	25	M3	13
A4		D4	16	G4	40	J4	27	M4	11
A5		D5	20	G5	48	J5	25	M5	10
A6		D6	19	G6	60	J6	23	M6	10
A7		D7	13	G7	98	J7	41	M7	9
► A8		D8		G8	163	J8	78	M8	13
A9		D9	30	G9	92	J9	93	M9	8
A10	4	D10	20	G10	91	J10	83	M10	5
A11		D11	12	G11	55	J11	50	M11	
A12		D12	8	G12	27	J12	12	M12	
A13		D13	6	G13	13	J13		M13	
A14		D14	7	G14	7	J14		M14	
A15		D15		G15	5	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	6	K1	6	N1	
B2		E2	9	H2	23	K2	14	N2	
B3		E3	18	H3	38	K3	20	N3	5
B4		E4	33	H4	36	K4	24	N4	6
B5	5	E5	40	H5	40	K5	18	N5	5
B6	4	E6	38	H6	80	K6	18	N6	4
B7		E7	43	H7	145	K7	25	N7	5
B8		E8	20	☼ H8		K8	50	N8	5
B9	11	E9	47	H9	163	K9	48	N9	
B10	7	E10	30	H10	75	K10	47	N10	
B11	7	E11	21	H11	76	K11	16	N11	
B12	5	E12	15	H12	37	K12	5	N12	
B13		E13	14	H13	13	K13		N13	
B14		E14	9	H14	6	K14		N14	
B15		E15		H15	4	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	5	I1	7	L1	4	O1	
C2		F2	10	I2	22	L2	11	O2	
C3		F3	27	I3	31	L3	16	O3	
C4	5	F4	36	I4	34	L4	12	O4	
C5	9	F5	45	I5	35	L5	12	O5	
C6	13	F6	53	I6	40	L6	15	O6	
C7	5	F7	61	I7	49	L7	14	O7	
C8		F8	35	I8	100	L8	33	O8	
C9	22	F9	91	I9	162	L9	24	O9	
C10	15	F10	46	I10	136	L10	19	O10	
C11	12	F11	40	I11	66	L11	5	O11	
C12	9	F12	16	I12	25	L12		O12	
C13	5	F13	11	I13	7	L13		O13	
C14		F14	10	I14		L14		O14	
C15		F15	4	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(61): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial:	28.0
Pressure (kg/cm^2)	2.00		Final:	29.5
Replication	R1	Rel. Hum. (%)	Initial:	90.0
Duration (hr)	1.00		Final:	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	5	J1	5	M1	
A2		D2		G2	17	J2	15	M2	4
A3		D3	7	G3	39	J3	34	M3	10
A4		D4	17	G4	52	J4	43	M4	14
A5		D5	24	G5	50	J5	39	M5	12
A6		D6	34	G6	64	J6	38	M6	13
A7		D7	33	G7	112	J7	39	M7	14
► A8		D8	4	G8	108	J8	94	M8	15
A9	4	D9	35	G9	125	J9	94	M9	17
A10	6	D10	25	G10	108	J10	92	M10	9
A11	5	D11	26	G11	82	J11	49	M11	4
A12		D12	15	G12	54	J12	17	M12	
A13		D13	8	G13	37	J13	5	M13	
A14		D14	10	G14	12	J14		M14	
A15		D15	4	G15	5	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	5	K1	4	N1	
B2		E2	7	H2	21	K2	11	N2	
B3		E3	23	H3	42	K3	24	N3	4
B4		E4	39	H4	53	K4	35	N4	5
B5		E5	45	H5	54	K5	28	N5	8
B6	4	E6	51	H6	99	K6	22	N6	7
B7		E7	75	H7	153	K7	27	N7	7
B8		E8	13	Ø H8		K8	50	N8	6
B9	18	E9	54	H9	208	K9	53	N9	5
B10	13	E10	52	H10	103	K10	59	N10	4
B11	10	E11	45	H11	75	K11	27	N11	
B12	6	E12	17	H12	40	K12	8	N12	
B13	4	E13	18	H13	16	K13		N13	
B14		E14	14	H14	4	K14		N14	
B15		E15	4	H15	4	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	4	I1	7	L1		O1	
C2		F2	13	I2	21	L2	7	O2	
C3		F3	38	I3	39	L3	18	O3	
C4	4	F4	49	I4	50	L4	23	O4	
C5	7	F5	16	I5	53	L5	19	O5	4
C6	14	F6	62	I6	74	L6	16	O6	4
C7	7	F7	86	I7	75	L7	17	O7	7
C8		F8	29	I8	129	L8	27	O8	5
C9	28	F9	108	I9	168	L9	35	O9	4
C10	21	F10	59	I10	163	L10	28	O10	
C11	16	F11	53	I11	75	L11	10	O11	
C12	11	F12	35	I12	24	L12	4	O12	
C13	7	F13	25	I13	5	L13		O13	
C14	4	F14	13	I14		L14		O14	
C15		F15	4	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: Ø denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(62): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JNBL	Temp. (°C)	Initial	28.5
Pressure (kg/cm^2)	2.00		Final	29.5
Replication:	R2	Rel. Hum. (%)	Initial	90.0
Duration (hr):	1.00		Final	89.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	4	J1	4	M1	
A2		D2		G2	14	J2	18	M2	5
A3		D3	6	G3	44	J3	39	M3	13
A4		D4	18	G4	53	J4	47	M4	9
A5		D5	21	G5	46	J5	36	M5	11
A6		D6	37	G6	71	J6	34	M6	12
A7		D7	28	G7	135	J7	48	M7	16
► A8		D8	8	G8	99	J8	102	M8	12
A9	5	D9	36	G9	148	J9	87	M9	13
A10	4	D10	21	G10	106	J10	96	M10	10
A11	4	D11	22	G11	72	J11	51	M11	5
A12		D12	18	G12	49	J12	11	M12	
A13		D13	5	G13	39	J13	7	M13	
A14		D14	12	G14	11	J14		M14	
A15		D15	6	G15	4	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	4	K1	4	N1	
B2		E2	4	H2	23	K2	12	N2	
B3		E3	27	H3	38	K3	21	N3	5
B4		E4	43	H4	64	K4	37	N4	4
B5		E5	48	H5	57	K5	29	N5	6
B6	6	E6	54	H6	121	K6	18	N6	9
B7		E7	85	H7	147	K7	28	N7	11
B8		E8	11	Ø H8		K8	61	N8	4
B9	15	E9	62	H9	221	K9	58	N9	6
B10	11	E10	49	H10	112	K10	49	N10	4
B11	9	E11	46	H11	69	K11	28	N11	
B12	7	E12	18	H12	38	K12	6	N12	
B13	4	E13	12	H13	14	K13		N13	
B14		E14	16	H14	7	K14		N14	
B15		E15	5	H15	5	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	4	I1	9	L1		O1	
C2		F2	15	I2	18	L2	11	O2	
C3		F3	39	I3	34	L3	22	O3	
C4	5	F4	46	I4	62	L4	20	O4	
C5	4	F5	14	I5	58	L5	17	O5	5
C6	12	F6	58	I6	83	L6	11	O6	4
C7	8	F7	97	I7	72	L7	16	O7	9
C8		F8	32	I8	117	L8	29	O8	5
C9	24	F9	117	I9	174	L9	32	O9	7
C10	22	F10	64	I10	158	L10	24	O10	
C11	14	F11	58	I11	77	L11	9	O11	
C12	12	F12	44	I12	21	L12	8	O12	
C13	9	F13	28	I13	7	L13		O13	
C14	5	F14	11	I14		L14		O14	
C15		F15	5	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: Ø denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(63): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JNBL	Temp. (°C)	Initial	27.0
Pressure (kg/cm^2)	2.00		Final:	28.0
Replication	R3	Rel. Hum. (%)	Initial:	91.0
Duration (hr).	1.00		Final:	90.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1	5	J1	5	M1	
A2		D2		G2	16	J2	17	M2	5
A3		D3	7	G3	42	J3	37	M3	10
A4		D4	18	G4	53	J4	45	M4	14
A5		D5	23	G5	48	J5	38	M5	12
A6		D6	36	G6	68	J6	36	M6	13
A7		D7	31	G7	124	J7	44	M7	15
► A8		D8	6	G8	104	J8	98	M8	14
A9	5	D9	36	G9	137	J9	91	M9	15
A10	5	D10	23	G10	107	J10	94	M10	10
A11	4	D11	24	G11	77	J11	50	M11	5
A12		D12	17	G12	52	J12	14	M12	
A13		D13	7	G13	38	J13	6	M13	
A14		D14	11	G14	12	J14		M14	
A15		D15	5	G15	5	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1	5	K1	4	N1	
B2		E2	6	H2	22	K2	12	N2	
B3		E3	25	H3	40	K3	23	N3	5
B4		E4	41	H4	59	K4	36	N4	5
B5		E5	47	H5	56	K5	29	N5	7
B6	5	E6	53	H6	110	K6	20	N6	8
B7		E7	80	H7	150	K7	28	N7	9
B8		E8	12	Ø H8		K8	56	N8	5
B9	17	E9	58	H9	215	K9	36	N9	6
B10	12	E10	51	H10	109	K10	54	N10	4
B11	10	E11	46	H11	72	K11	28	N11	
B12	7	E12	18	H12	39	K12	7	N12	
B13	4	E13	15	H13	15	K13		N13	
B14		E14	15	H14	6	K14		N14	
B15		E15	5	H15	5	K15		N15	
B16		E16		H16		K16		N16	
C1		F1	4	I1	8	L1		O1	
C2		F2	14	I2	20	L2	9	O2	
C3		F3	39	I3	37	L3	20	O3	
C4	5	F4	48	I4	56	L4	22	O4	
C5	6	F5	15	I5	56	L5	18	O5	5
C6	13	F6	60	I6	79	L6	14	O6	4
C7	8	F7	92	I7	74	L7	11	O7	8
C8		F8	31	I8	123	L8	28	O8	5
C9	26	F9	113	I9	111	L9	34	O9	6
C10	22	F10	62	I10	161	L10	26	O10	
C11	15	F11	56	I11	76	L11	10	O11	
C12	12	F12	40	I12	23	L12	6	O12	
C13	8	F13	27	I13	6	L13		O13	
C14	5	F14	12	I14		L14		O14	
C15		F15	5	I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: Ø denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(64): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-NG	Temp. (°C)	Initial.	28.5
Pressure (kg/cm^2):	1.00		Final	30.0
Replication:	R1	Rel. Hum. (%)	Initial	89.0
Duration (hr):	1.00		Final	87.5
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	8	J3	4	M3	
A4		D4	4	G4	25	J4	15	M4	
A5		D5	12	G5	42	J5	33	M5	
A6		D6	23	G6	25	J6	39	M6	4
A7		D7	28	G7	10	J7	36	M7	6
► A8		D8	7	G8	32	J8	35	M8	8
A9		D9	31	G9	11	J9	36	M9	9
A10		D10	30	G10	22	J10	40	M10	5
A11		D11	22	G11	44	J11	38	M11	
A12		D12	6	G12	35	J12	24	M12	
A13		D13		G13	20	J13	11	M13	
A14		D14		G14	4	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	8	K3		N3	
B4		E4	11	H4	26	K4		N4	
B5		E5	26	H5	40	K5	7	N5	
B6		E6	39	H6	23	K6	23	N6	
B7		E7	38	H7	9	K7	36	N7	
B8		E8	11	Ø H8		K8	40	N8	
B9		E9	36	H9	11	K9	38	N9	
B10		E10	37	H10	24	K10	39	N10	
B11		E11	35	H11	46	K11	35	N11	
B12		E12	24	H12	27	K12	27	N12	
B13		E13	5	H13	22	K13	16	N13	
B14		E14		H14	4	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	4	I3	6	L3		O3	
C4		F4	17	I4	20	L4		O4	
C5		F5	37	I5	37	L5	6	O5	
C6	7	F6	36	I6	33	L6	18	O6	
C7	10	F7	25	I7	18	L7	29	O7	
C8	9	F8	16	I8	12	L8	30	O8	
C9	12	F9	23	I9	16	L9	31	O9	
C10	8	F10	35	I10	35	L10	20	O10	
C11	4	F11	37	I11	45	L11	13	O11	
C12		F12	28	I12	24	L12		O12	
C13		F13	16	I13	20	L13		O13	
C14		F14		I14	4	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: Ø denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(65): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-NG	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	1.00		Final	27.0
Replication	R2	Rel. Hum. (%)	Initial	90.5
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3	5	M3	
A4		D4	4	G4	26	J4	12	M4	
A5		D5	8	G5	44	J5	34	M5	
A6		D6	27	G6	28	J6	41	M6	5
A7		D7	19	G7	9	J7	38	M7	7
► A8		D8	13	G8	37	J8	32	M8	9
A9		D9	34	G9	12	J9	33	M9	5
A10		D10	28	G10	20	J10	42	M10	4
A11		D11	26	G11	49	J11	35	M11	
A12		D12	5	G12	32	J12	23	M12	
A13		D13		G13	19	J13	10	M13	
A14		D14		G14	5	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4	9	H4	29	K4		N4	
B5		E5	25	H5	38	K5	6	N5	
B6		E6	42	H6	22	K6	22	N6	
B7		E7	34	H7	12	K7	37	N7	
B8		E8	14	⊙ H8		K8	42	N8	
B9		E9	38	H9	8	K9	35	N9	
B10		E10	31	H10	26	K10	36	N10	
B11		E11	33	H11	44	K11	42	N11	
B12		E12	26	H12	25	K12	29	N12	
B13		E13	7	H13	21	K13	14	N13	
B14		E14		H14	5	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	4	I3	4	L3		O3	
C4		F4	19	I4	22	L4		O4	
C5		F5	32	I5	32	L5	7	O5	
C6	5	F6	35	I6	36	L6	13	O6	
C7	8	F7	28	I7	17	L7	28	O7	
C8	11	F8	19	I8	11	L8	38	O8	
C9	10	F9	22	I9	18	L9	34	O9	
C10	7	F10	13	I10	33	L10	16	O10	
C11	6	F11	34	I11	46	L11	12	O11	
C12		F12	29	I12	21	L12		O12	
C13		F13	12	I13	18	L13		O13	
C14		F14		I14	7	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(66): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-NG	Temp. (°C)	Initial	27.5
Pressure (kg/cm²)	1.00		Final	28.0
Replication	R3	Rel. Hum. (%)	Initial	90.0
Duration (hr)	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	5	J3	5	M3	
A4		D4	4	G4	28	J4	12	M4	
A5		D5	10	G5	40	J5	32	M5	
A6		D6	22	G6	29	J6	43	M6	7
A7		D7	26	G7	16	J7	38	M7	4
► A8		D8	10	G8	36	J8	34	M8	5
A9		D9	35	G9	14	J9	36	M9	6
A10		D10	30	G10	26	J10	39	M10	4
A11		D11	19	G11	38	J11	44	M11	
A12		D12	7	G12	32	J12	22	M12	
A13		D13		G13	26	J13	14	M13	
A14		D14		G14	4	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3	6	K3		N3	
B4		E4	8	H4	24	K4		N4	
B5		E5	28	H5	32	K5	9	N5	
B6		E6	44	H6	28	K6	20	N6	
B7		E7	35	H7	10	K7	39	N7	
B8		E8	9	⊙ H8		K8	36	N8	
B9		E9	38	H9	8	K9	32	N9	
B10		E10	32	H10	26	K10	42	N10	
B11		E11	30	H11	41	K11	37	N11	
B12		E12	22	H12	29	K12	25	N12	
B13		E13	6	H13	20	K13	14	N13	
B14		E14		H14	9	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3	8	L3		O3	
C4		F4	18	I4	16	L4		O4	
C5		F5	32	I5	35	L5	5	O5	
C6	6	F6	34	I6	38	L6	14	O6	
C7	9	F7	28	I7	14	L7	33	O7	
C8	8	F8	14	I8	16	L8	32	O8	
C9	10	F9	28	I9	15	L9	30	O9	
C10	7	F10	32	I10	32	L10	22	O10	
C11	5	F11	33	I11	49	L11	9	O11	
C12		F12	26	I12	22	L12		O12	
C13		F13	7	I13	22	L13		O13	
C14		F14		I14	5	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(67): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-NG	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	1.25		Final	28.0
Replication	R1	Rel. Hum. (%)	Initial	91.0
Duration (hr)	1.00		Final	90.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3	4	M3	
A4		D4	4	G4	20	J4	14	M4	
A5		D5	15	G5	38	J5	24	M5	
A6		D6	20	G6	27	J6	38	M6	5
A7		D7	18	G7	14	J7	40	M7	12
► A8		D8	7	G8	41	J8	39	M8	15
A9		D9	18	G9	13	J9	40	M9	14
A10		D10	21	G10	27	J10	44	M10	8
A11		D11	22	G11	36	J11	33	M11	5
A12		D12	12	G12	26	J12	22	M12	
A13		D13		G13	21	J13	13	M13	
A14		D14		G14	4	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	4	H3	8	K3		N3	
B4		E4	12	H4	21	K4	9	N4	
B5		E5	22	H5	39	K5	19	N5	
B6		E6	27	H6	26	K6	23	N6	
B7		E7	37	H7	12	K7	33	N7	
B8	10	E8	15	⊙ H8		K8	37	N8	4
B9	4	E9	13	H9	11	K9	35	N9	
B10		E10	27	H10	26	K10	27	N10	
B11		E11	22	H11	39	K11	23	N11	
B12		E12	25	H12	26	K12	16	N12	
B13		E13	7	H13	18	K13	7	N13	
B14		E14		H14	4	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	6	I3	6	L3		O3	
C4		F4	17	I4	20	L4		O4	
C5	4	F5	27	I5	36	L5	11	O5	
C6	10	F6	37	I6	37	L6	21	O6	
C7	12	F7	27	I7	27	L7	23	O7	
C8	8	F8	18	I8	16	L8	23	O8	
C9	19	F9	26	I9	17	L9	25	O9	
C10	16	F10	35	I10	37	L10	22	O10	
C11	8	F11	27	I11	42	L11	16	O11	
C12		F12	24	I12	24	L12	7	O12	
C13		F13	16	I13	17	L13		O13	
C14		F14		I14	4	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(68): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-NG	Temp. (°C)	Initial	28.5
Pressure (kg/cm²)	1.25		Final	29.0
Replication	R2	Rel. Hum. (%)	Initial	90.0
Duration (hr)	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3	5	M3	
A4		D4	4	G4	22	J4	16	M4	
A5		D5	21	G5	29	J5	29	M5	
A6		D6	16	G6	36	J6	34	M6	[illegible]
A7		D7	15	G7	18	J7	39	M7	
► A8		D8	9	G8	19	J8	46	M8	16
A9		D9	17	G9	38	J9	48	M9	[illegible]
A10		D10	24	G10	26	J10	42	M10	[illegible]
A11		D11	20	G11	34	J11	30	M11	[illegible]
A12		D12	9	G12	22	J12	19	M12	
A13		D13		G13	26	J13	[illegible]	M13	
A14		D14		G14	11	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	6	H3	5	K3		N3	
B4		E4	14	H4	18	K4	12	N4	
B5		E5	17	H5	27	K5	16	N5	
B6		E6	26	H6	40	K6	23	N6	
B7	5	E7	41	H7	11	K7	19	N7	
B8	6	E8	13	⊙ H8		K8	32	N8	
B9	4	E9	28	H9	16	K9	29	N9	4
B10		E10	29	H10	22	K10	28	N10	
B11		E11	18	H11	41	K11	22	N11	
B12		E12	23	H12	29	K12	17	N12	
B13		E13	8	H13	17	K13	8	N13	
B14		E14		H14	7	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3	5	L3		O3	
C4		F4	14	I4	18	L4		O4	
C5	5	F5	29	I5	34	L5	14	O5	
C6	9	F6	36	I6	39	L6	19	O6	
C7	11	F7	21	I7	26	L7	25	O7	
C8	9	F8	17	I8	13	L8	20	O8	
C9	22	F9	29	I9	19	L9	23	O9	
C10	14	F10	33	I10	39	L10	19	O10	
C11	7	F11	24	I11	36	L11	15	O11	
C12		F12	26	I12	28	L12	4	O12	
C13		F13	13	I13	14	L13		O13	
C14		F14		I14	7	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(69): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-NG	Temp. (°C)	Initial:	26.0
Pressure (kg/cm²):	1.25		Final:	26.5
Replication:	R3	Rel. Hum. (%)	Initial:	92.0
Duration (hr):	1.00		Final:	92.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3	6	M3	
A4		D4	7	G4	25	J4	19	M4	
A5		D5	18	G5	22	J5	24	M5	
A6		D6	14	G6	33	J6	33	M6	11
A7		D7	13	G7	19	J7	41	M7	12
► A8		D8	11	G8	14	J8	38	M8	14
A9		D9	16	G9	41	J9	42	M9	10
A10		D10	27	G10	25	J10	39	M10	6
A11		D11	22	G11	31	J11	21	M11	4
A12		D12	4	G12	25	J12	22	M12	
A13		D13		G13	21	J13	14	M13	
A14		D14		G14	12	J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	5	H3	7	K3		N3	
B4		E4	16	H4	16	K4	14	N4	
B5		E5	21	H5	24	K5	19	N5	
B6		E6	24	H6	35	K6	20	N6	
B7	4	E7	34	H7	12	K7	35	N7	
B8	5	E8	18	⊙ H8		K8	34	N8	
B9	4	E9	22	H9	19	K9	26	N9	4
B10		E10	27	H10	21	K10	23	N10	
B11		E11	28	H11	38	K11	27	N11	
B12		E12	14	H12	26	K12	14	N12	
B13		E13	6	H13	15	K13	7	N13	
B14		E14		H14	9	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	7	I3	8	L3		O3	
C4		F4	11	I4	14	L4		O4	
C5	6	F5	31	I5	32	L5	15	O5	
C6	7	F6	30	I6	36	L6	15	O6	
C7	14	F7	22	I7	28	L7	29	O7	
C8	10	F8	14	I8	15	L8	24	O8	
C9	17	F9	32	I9	16	L9	22	O9	
C10	16	F10	37	I10	41	L10	16	O10	
C11	5	F11	22	I11	32	L11	13	O11	
C12		F12	25	I12	26	L12	5	O12	
C13		F13	9	I13	13	L13		O13	
C14		F14		I14	9	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(70): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-NG	Temp. (°C)	Initial:	26.0
Pressure (kg/cm²):	1.50		Final:	26.5
Replication:	R1	Rel. Hum. (%)	Initial:	92.0
Duration (hr):	1.00		Final:	91.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	7	J3	4	M3	
A4		D4	4	G4	17	J4	14	M4	
A5		D5	13	G5	33	J5	20	M5	
A6		D6	17	G6	41	J6	44	M6	4
A7		D7	16	G7	27	J7	65	M7	9
► A8		D8	5	G8	43	J8	65	M8	10
A9		D9	17	G9	26	J9	65	M9	10
A10		D10	18	G10	43	J10	48	M10	7
A11		D11	18	G11	37	J11	34	M11	5
A12		D12	12	G12	22	J12	38	M12	
A13		D13	5	G13	17	J13	10	M13	
A14		D14		G14	6	J14	5	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	4	H3	8	K3		N3	
B4		E4	12	H4	17	K4	7	N4	
B5		E5	18	H5	39	K5	15	N5	
B6		E6	23	H6	38	K6	23	N6	
B7		E7	27	H7	23	K7	34	N7	4
B8	4	E8	13	⊙ H8		K8	38	N8	4
B9	4	E9	37	H9	25	K9	38	N9	4
B10	4	E10	28	H10	41	K10	27	N10	
B11		E11	18	H11	42	K11	19	N11	
B12		E12	20	H12	23	K12	12	N12	
B13		E13	9	H13	16	K13	6	N13	
B14		E14		H14	7	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	5	I3	6	L3		O3	
C4		F4	15	I4	18	L4	4	O4	
C5	4	F5	18	I5	36	L5	7	O5	
C6	8	F6	40	I6	45	L6	14	O6	
C7	7	F7	42	I7	39	L7	20	O7	
C8	4	F8	17	I8	34	L8	20	O8	
C9	16	F9	42	I9	32	L9	20	O9	
C10	13	F10	44	I10	50	L10	16	O10	
C11	8	F11	27	I11	44	L11	11	O11	
C12		F12	39	I12	20	L12	7	O12	
C13		F13	16	I13	14	L13		O13	
C14		F14	4	I14	6	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(71): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-NG	Temp. (°C)	Initial:	27.0
Pressure (kg/cm²):	1.50		Final:	27.0
Replication:	R2	Rel. Hum. (%)	Initial:	91.0
Duration (hr):	1.00		Final:	90.5
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	9	J3	5	M3	
A4		D4	8	G4	14	J4	16	M4	
A5		D5	11	G5	39	J5	19	M5	
A6		D6	14	G6	35	J6	48	M6	8
A7		D7	18	G7	24	J7	63	M7	4
► A8		D8	9	G8	52	J8	68	M8	13
A9		D9	12	G9	28	J9	59	M9	7
A10		D10	16	G10	47	J10	44	M10	4
A11		D11	21	G11	33	J11	35	M11	6
A12		D12	9	G12	18	J12	17	M12	
A13		D13	7	G13	20	J13	9	M13	
A14		D14		G14	7	J14	4	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	4	H3	4	K3		N3	
B4		E4	11	H4	14	K4	6	N4	
B5		E5	22	H5	42	K5	18	N5	
B6		E6	17	H6	49	K6	24	N6	
B7		E7	31	H7	20	K7	37	N7	4
B8	5	E8	12	⊙ H8		K8	39	N8	7
B9	4	E9	30	H9	26	K9	32	N9	5
B10	4	E10	28	H10	38	K10	20	N10	
B11		E11	14	H11	45	K11	18	N11	
B12		E12	22	H12	22	K12	14	N12	
B13		E13	12	H13	14	K13	7	N13	
B14		E14		H14	6	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	4	I3	4	L3		O3	
C4		F4	13	I4	15	L4	8	O4	
C5	6	F5	19	I5	39	L5	6	O5	
C6	4	F6	36	I6	42	L6	11	O6	
C7	9	F7	44	I7	38	L7	19	O7	
C8	5	F8	14	I8	36	L8	24	O8	
C9	12	F9	45	I9	30	L9	15	O9	
C10	17	F10	19	I10	54	L10	14	O10	
C11	4	F11	28	I11	42	L11	12	O11	
C12		F12	15	I12	26	L12	8	O12	
C13		F13	12	I13	13	L13		O13	
C14		F14	8	I14	8	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(72): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-NG	Temp. (°C)	Initial:	27.5
Pressure (kg/cm²):	1.50		Final:	28.5
Replication:	R3	Rel. Hum. (%)	Initial:	90.0
Duration (hr):	1.00		Final:	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3	4	J3	7	M3	
A4		D4	6	G4	15	J4	21	M4	
A5		D5	9	G5	42	J5	16	M5	
A6		D6	13	G6	31	J6	44	M6	5
A7		D7	16	G7	27	J7	62	M7	5
► A8		D8	11	G8	59	J8	54	M8	14
A9		D9	18	G9	22	J9	56	M9	6
A10		D10	14	G10	51	J10	39	M10	8
A11		D11	13	G11	38	J11	41	M11	9
A12		D12	10	G12	16	J12	19	M12	
A13		D13	4	G13	13	J13	7	M13	
A14		D14		G14	8	J14	5	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3	5	H3	5	K3		N3	
B4		E4	17	H4	16	K4	7	N4	
B5		E5	14	H5	43	K5	14	N5	
B6		E6	16	H6	51	K6	22	N6	
B7		E7	25	H7	34	K7	39	N7	[illegible]
B8	4	E8	14	⊙ H8		K8	36	N8	[illegible]
B9	4	E9	29	H9	22	K9	35	N9	4
B10	8	E10	32	H10	32	K10	31	N10	
B11		E11	16	H11	48	K11	19	N11	
B12		E12	20	H12	20	K12	12	N12	
B13		E13	9	H13	12	K13	8	N13	
B14		E14		H14	7	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3	8	I3	9	L3		O3	
C4		F4	10	I4	11	L4	5	O4	
C5	5	F5	16	I5	44	L5	5	O5	
C6	8	F6	39	I6	38	L6	14	O6	
C7	12	F7	39	I7	36	L7	20	O7	
C8	4	F8	12	I8	28	L8	21	O8	
C9	10	F9	42	I9	32	L9	12	O9	
C10	14	F10	34	I10	62	L10	12	O10	
C11	4	F11	27	I11	39	L11	10	O11	
C12		F12	12	I12	31	L12	4	O12	
C13		F13	12	I13	18	L13		O13	
C14		F14	9	I14	4	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ⊙ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(73): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp. (°C)	Initial	29.0
Pressure (kg/cm²)	1.50		Final	29.0
Replication	R1	Rel. Hum. (%)	Initial	90.5
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	4	J5		M5	
A6		D6		G6	39	J6	19	M6	
A7		D7		G7	290	J7	60	M7	
▶ A8		D8		G8	455	J8	105	M8	
A9		D9		G9	62	J9	61	M9	
A10		D10		G10	164	J10	64	M10	
A11		D11		G11	23	J11	90	M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	14	K5		N5	
B6		E6		H6	85	K6		N6	
B7		E7		H7	520	K7	19	N7	
B8		E8	4	○ H8		K8	68	N8	
B9		E9	9	H9	13	K9	60	N9	
B10		E10		H10	67	K10	48	N10	
B11		E11		H11	86	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	4	L5		O5	
C6		F6		I6	82	L6		O6	
C7		F7	20	I7	246	L7		O7	
C8		F8	25	I8	15	L8	4	O8	
C9		F9	160	I9	10	L9	4	O9	
C10		F10	12	I10	80	L10		O10	
C11		F11	4	I11	52	L11		O11	
C12		F12		I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(74): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp. (°C)	Initial	29.0
Pressure (kg/cm²)	1.50		Final	28.0
Replication	R2	Rel. Hum. (%)	Initial	88.0
Duration (hr)	1.00		Final	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	8	J5		M5	
A6		D6		G6	56	J6	30	M6	
A7		D7		G7	276	J7	46	M7	
▶ A8		D8		G8	480	J8	124	M8	
A9		D9		G9	67	J9	64	M9	
A10		D10		G10	130	J10	68	M10	
A11		D11		G11	18	J11	55	M11	
A12		D12		G12	9	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	26	K5		N5	
B6		E6		H6	72	K6		N6	
B7		E7		H7	610	K7	26	N7	
B8		E8	7	○ H8		K8	43	N8	
B9		E9	8	H9	22	K9	82	N9	
B10		E10		H10	34	K10	39	N10	
B11		E11		H11	65	K11		N11	
B12		E12		H12	8	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	5	L5		O5	
C6		F6		I6	90	L6		O6	
C7		F7	32	I7	225	L7		O7	
C8		F8	18	I8	22	L8	8	O8	
C9		F9	124	I9	14	L9	4	O9	
C10		F10	27	I10	68	L10		O10	
C11		F11	6	I11	42	L11		O11	
C12		F12		I12	12	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(75): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp. (°C)	Initial	27.0
Pressure (kg/cm²)	1.50		Final	27.5
Replication	R3	Rel. Hum. (%)	Initial	92.0
Duration (hr)	1.00		Final	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	5	J5		M5	
A6		D6		G6	28	J6	38	M6	
A7		D7		G7	310	J7	56	M7	
▶ A8		D8		G8	425	J8	145	M8	
A9		D9		G9	48	J9	57	M9	
A10		D10		G10	128	J10	124	M10	
A11		D11		G11	16	J11	82	M11	
A12		D12		G12	7	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	18	K5		N5	
B6		E6		H6	96	K6		N6	
B7		E7		H7	460	K7	32	N7	
B8		E8	6	○ H8		K8	57	N8	
B9		E9	4	H9	11	K9	72	N9	
B10		E10		H10	72	K10	29	N10	
B11		E11		H11	94	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	4	L5		O5	
C6		F6		I6	72	L6		O6	
C7		F7	12	I7	310	L7		O7	
C8		F8	28	I8	28	L8	12	O8	
C9		F9	117	I9	6	L9	4	O9	
C10		F10	15	I10	110	L10		O10	
C11		F11	8	I11	48	L11		O11	
C12		F12		I12	6	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(76): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp. (°C)	Initial	28.0
Pressure (kg/cm²)	2.00		Final	29.0
Replication	R1	Rel. Hum. (%)	Initial	90.0
Duration (hr)	1.00		Final	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	5	M5	
A6		D6		G6	7	J6	97	M6	
A7		D7		G7	517	J7	212	M7	
▶ A8		D8		G8	145	J8	129	M8	
A9		D9		G9	148	J9	122	M9	
A10		D10		G10	85	J10	56	M10	
A11		D11		G11	8	J11	22	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	4	K5		N5	
B6		E6		H6	178	K6	10	N6	
B7		E7		H7	83	K7	52	N7	
B8		E8		○ H8		K8	60	N8	
B9		E9		H9	64	K9	34	N9	
B10		E10		H10	117	K10	23	N10	
B11		E11		H11	38	K11	5	N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	6	L5		O5	
C6		F6		I6	242	L6		O6	
C7		F7	8	I7	138	L7		O7	
C8		F8	9	I8	101	L8	7	O8	
C9		F9	35	I9	84	L9	8	O9	
C10		F10	6	I10	103	L10	4	O10	
C11		F11		I11	34	L11		O11	
C12		F12		I12	5	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ▶ denotes direction of the frame of the emitter towards that point)

Appendix IV(73): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp (°C)	Initial:	29.0
Pressure (kg/cm²)	1.50		Final:	29.0
Replication	R1	Rel. Hum. (%)	Initial:	90.5
Duration (hr)	1.00		Final:	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	4	J5		M5	
A6		D6		G6	39	J6	19	M6	
A7		D7		G7	290	J7	60	M7	
► A8		D8		G8	455	J8	105	M8	
A9		D9		G9	62	J9	61	M9	
A10		D10		G10	164	J10	64	M10	
A11		D11		G11	23	J11	90	M11	
A12		D12		G12	4	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	14	K5		N5	
B6		E6		H6	85	K6		N6	
B7		E7		H7	320	K7	19	N7	
B8		E8	4	○ H8		K8	68	N8	
B9		E9	9	H9	13	K9	60	N9	
B10		E10		H10	67	K10	48	N10	
B11		E11		H11	86	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	4	L5		O5	
C6		F6		I6	82	L6		O6	
C7		F7	20	I7	246	L7		O7	
C8		F8	25	I8	15	L8	4	O8	
C9		F9	160	I9	10	L9	4	O9	
C10		F10	12	I10	80	L10		O10	
C11		F11	4	I11	52	L11		O11	
C12		F12		I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(74): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp (°C)	Initial:	29.0
Pressure (kg/cm²)	1.50		Final:	28.0
Replication	R2	Rel. Hum. (%)	Initial:	88.0
Duration (hr)	1.00		Final:	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	8	J5		M5	
A6		D6		G6	56	J6	30	M6	
A7		D7		G7	276	J7	46	M7	
► A8		D8		G8	480	J8	124	M8	
A9		D9		G9	67	J9	61	M9	
A10		D10		G10	130	J10	68	M10	
A11		D11		G11	18	J11	55	M11	
A12		D12		G12	9	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	26	K5		N5	
B6		E6		H6	72	K6		N6	
B7		E7		H7	610	K7	26	N7	
B8		E8	7	○ H8		K8	43	N8	
B9		E9	8	H9	22	K9	92	N9	
B10		E10		H10	34	K10	39	N10	
B11		E11		H11	65	K11		N11	
B12		E12		H12	8	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	5	L5		O5	
C6		F6		I6	90	L6		O6	
C7		F7	32	I7	225	L7		O7	
C8		F8	18	I8	22	L8	8	O8	
C9		F9	124	I9	14	L9	4	O9	
C10		F10	27	I10	68	L10		O10	
C11		F11	6	I11	42	L11		O11	
C12		F12		I12	12	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(75): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp (°C)	Initial:	27.0
Pressure (kg/cm²)	1.50		Final:	27.5
Replication	R1	Rel. Hum. (%)	Initial:	92.0
Duration (hr)	1.00		Final:	91.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5	5	J5		M5	
A6		D6		G6	28	J6	38	M6	
A7		D7		G7	310	J7	56	M7	
► A8		D8		G8	425	J8	145	M8	
A9		D9		G9	48	J9	57	M9	
A10		D10		G10	128	J10	124	M10	
A11		D11		G11	16	J11	82	M11	
A12		D12		G12	7	J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	18	K5		N5	
B6		E6		H6	96	K6		N6	
B7		E7		H7	460	K7	32	N7	
B8		E8	6	○ H8		K8	57	N8	
B9		E9	4	H9	11	K9	72	N9	
B10		E10		H10	72	K10	29	N10	
B11		E11		H11	94	K11		N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	4	L5		O5	
C6		F6		I6	72	L6		O6	
C7		F7	12	I7	310	L7		O7	
C8		F8	28	I8	28	L8	12	O8	
C9		F9	117	I9	6	L9	4	O9	
C10		F10	15	I10	110	L10		O10	
C11		F11	8	I11	48	L11		O11	
C12		F12		I12	6	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(76): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp (°C)	Initial:	28.0
Pressure (kg/cm²)	2.00		Final:	29.0
Replication	R1	Rel. Hum. (%)	Initial:	90.0
Duration (hr)	1.00		Final:	88.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	5	M5	
A6		D6		G6	7	J6	97	M6	
A7		D7		G7	517	J7	212	M7	
► A8		D8		G8	145	J8	129	M8	
A9		D9		G9	148	J9	122	M9	
A10		D10		G10	85	J10	56	M10	
A11		D11		G11	8	J11	22	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	4	K5		N5	
B6		E6		H6	178	K6	10	N6	
B7		E7		H7	83	K7	52	N7	
B8		E8		○ H8		K8	60	N8	
B9		E9		H9	64	K9	34	N9	
B10		E10		H10	117	K10	23	N10	
B11		E11		H11	38	K11	5	N11	
B12		E12		H12	5	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	6	L5		O5	
C6		F6		I6	242	L6		O6	
C7		F7	8	I7	138	L7		O7	
C8		F8	9	I8	101	L8	7	O8	
C9		F9	35	I9	84	L9	8	O9	
C10		F10	6	I10	103	L10	4	O10	
C11		F11		I11	34	L11		O11	
C12		F12		I12	5	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(77): Catch-can data (Amount of water obtained in catch-cans)

Emitter: D-LG
Pressure (kg/cm²): 2.00
Replication: R2
Duration (hr): 1.00
Wind Data: No wind (closed indoors)
Temp (°C): Initial 29.0, Final 29.0
Rel. Hum. (%): Initial 90.0, Final 89.5

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	8	M5	
A6		D6		G6	12	J6	76	M6	
A7		D7		G7	485	J7	265	M7	
► A8		D8		G8	210	J8	114	M8	
A9		D9		G9	130	J9	96	M9	
A10		D10		G10	68	J10	48	M10	
A11		D11		G11	10	J11	24	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	8	K5		N5	
B6		E6		H6	195	K6	6	N6	
B7		E7		H7	88	K7	69	N7	
B8		E8		○ H8		K8	48	N8	
B9		E9		H9	35	K9	27	N9	
B10		E10		H10	155	K10	25	N10	
B11		E11		H11	26	K11	8	N11	
B12		E12		H12	12	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	14	L5		O5	
C6		F6		I6	285	L6		O6	
C7		F7	5	I7	126	L7		O7	
C8		F8	12	I8	92	L8	6	O8	
C9		F9	28	I9	76	L9	12	O9	
C10		F10	10	I10	132	L10	4	O10	
C11		F11		I11	45	L11		O11	
C12		F12		I12	4	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(78): Catch-can data (Amount of water obtained in catch-cans)

Emitter: D-LG
Pressure (kg/cm²): 2.00
Replication: R3
Duration (hr): 1.00
Wind Data: No wind (closed indoors)
Temp (°C): Initial 29.5, Final 28.0
Rel. Hum. (%): Initial 89.0, Final 90.5

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	6	M5	
A6		D6		G6	4	J6	46	M6	
A7		D7		G7	485	J7	225	M7	
► A8		D8		G8	184	J8	120	M8	
A9		D9		G9	230	J9	95	M9	
A10		D10		G10	94	J10	64	M10	
A11		D11		G11	10	J11	18	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	8	K5		N5	
B6		E6		H6	164	K6	18	N6	
B7		E7		H7	95	K7	12	N7	
B8		E8		○ H8		K8	125	N8	
B9		E9		H9	58	K9	24	N9	
B10		E10		H10	86	K10	12	N10	
B11		E11		H11	49	K11	7	N11	
B12		E12		H12	4	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	4	L5		O5	
C6		F6		I6	215	L6		O6	
C7		F7	12	I7	152	L7		O7	
C8		F8	6	I8	120	L8	5	O8	
C9		F9	34	I9	95	L9	17	O9	
C10		F10	7	I10	116	L10	8	O10	
C11		F11		I11	28	L11		O11	
C12		F12		I12	13	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(79): Catch-can data (Amount of water obtained in catch-cans)

Emitter: D-LG
Pressure (kg/cm²): 2.50
Replication: R1
Duration (hr): 1.00
Wind Data: No wind (closed indoors)
Temp (°C): Initial 27.0, Final 28.5
Rel. Hum. (%): Initial 92.0, Final 90.0

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	10	M5	
A6		D6		G6	15	J6	93	M6	
A7		D7		G7	490	J7	170	M7	
► A8		D8		G8	255	J8	130	M8	
A9		D9		G9	170	J9	110	M9	
A10		D10		G10	65	J10	75	M10	
A11		D11		G11	15	J11	20	M11	
A12		D12		G12		J12	5	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	5	K5		N5	
B6		E6		H6	195	K6	45	N6	
B7		E7		H7	80	K7	55	N7	
B8		E8		○ H8		K8	80	N8	
B9		E9		H9	95	K9	50	N9	
B10		E10		H10	105	K10	25	N10	
B11		E11		H11	35	K11	10	N11	
B12		E12		H12	6	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	15	L5		O5	
C6		F6		I6	260	L6		O6	
C7		F7	15	I7	137	L7	10	O7	
C8		F8	15	I8	125	L8	20	O8	
C9		F9	50	I9	85	L9	20	O9	
C10		F10	10	I10	110	L10	15	O10	
C11		F11		I11	25	L11		O11	
C12		F12		I12	10	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(80): Catch-can data (Amount of water obtained in catch-cans)

Emitter: D-LG
Pressure (kg/cm²): 2.50
Replication: R2
Duration (hr): 1.00
Wind Data: No wind (closed indoors)
Temp (°C): Initial 28.5, Final 27.5
Rel. Hum. (%): Initial 89.5, Final 89.5

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	13	M5	
A6		D6		G6	6	J6	85	M6	
A7		D7		G7	420	J7	196	M7	
► A8		D8		G8	310	J8	128	M8	
A9		D9		G9	145	J9	135	M9	
A10		D10		G10	54	J10	58	M10	
A11		D11		G11	8	J11	32	M11	
A12		D12		G12		J12	34	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	14	K5		N5	
B6		E6		H6	225	K6	64	N6	
B7		E7		H7	65	K7	48	N7	
B8		E8		○ H8		K8	96	N8	
B9		E9		H9	84	K9	18	N9	
B10		E10		H10	136	K10	24	N10	
B11		E11		H11	32	K11	8	N11	
B12		E12		H12	10	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	12	L5		O5	
C6		F6		I6	285	L6		O6	
C7		F7	12	I7	114	L7	7	O7	
C8		F8	10	I8	168	L8	19	O8	
C9		F9	68	I9	49	L9	34	O9	
C10		F10	14	I10	126	L10	12	O10	
C11		F11		I11	32	L11		O11	
C12		F12		I12	7	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ○ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(B1): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-LG	Temp (°C)	Initial:	26.5
Pressure (kg/cm²)	2.50		Final:	27.0
Replication	R3	Rel. Hum (%)	Initial:	92.0
Duration (hr)	1.00		Final:	91.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4		J4		M4	
A5		D5		G5		J5	12	M5	
A6		D6		G6	19	J6	72	M6	
A7		D7		G7	430	J7	142	M7	
► A8		D8		G8	214	J8	120	M8	
A9		D9		G9	186	J9	98	M9	
A10		D10		G10	87	J10	64	M10	
A11		D11		G11	12	J11	22	M11	
A12		D12		G12		J12	11	M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4		K4		N4	
B5		E5		H5	12	K5		N5	
B6		E6		H6	146	K6	26	N6	
B7		E7		H7	68	K7	44	N7	
B8		E8		◻ H8		K8	97	N8	
B9		E9		H9	116	K9	64	N9	
B10		E10		H10	89	K10	13	N10	
B11		E11		H11	42	K11	8	N11	
B12		E12		H12	11	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4		L4		O4	
C5		F5		I5	9	L5		O5	
C6		F6		I6	218	L6		O6	
C7		F7	8	I7	164	L7	8	O7	
C8		F8	22	I8	185	L8	19	O8	
C9		F9	46	I9	61	L9	28	O9	
C10		F10	14	I10	122	L10	9	O10	
C11		F11		I11	34	L11		O11	
C12		F12		I12	5	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(B2): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-BR	Temp (°C)	Initial	28.0
Pressure (kg/cm²)	1.00		Final	28.5
Replication	R1	Rel. Hum (%)	Initial	91.5
Duration (hr)	1.00		Final	89.5
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	4	J2	4	M2	
A3		D3		G3	16	J3	15	M3	
A4		D4	7	G4	17	J4	16	M4	
A5		D5	18	G5	39	J5	20	M5	7
A6		D6	19	G6	58	J6	49	M6	17
A7		D7	12	G7	71	J7	72	M7	21
► A8		D8	13	G8	97	J8	64	M8	16
A9		D9	17	G9	46	J9	59	M9	18
A10		D10	20	G10	38	J10	37	M10	17
A11		D11	16	G11	14	J11	18	M11	7
A12		D12	4	G12	13	J12	16	M12	
A13		D13		G13	10	J13	15	M13	
A14		D14		G14	18	J14	4	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	5	K2		N2	
B3		E3	4	H3	12	K3	8	N3	
B4		E4	16	H4	19	K4	7	N4	
B5		E5	39	H5	31	K5	16	N5	
B6		E6	26	H6	37	K6	21	N6	4
B7	4	E7	36	H7	32	K7	35	N7	12
B8	4	E8	10	◻ H8		K8	36	N8	11
B9	6	E9	19	H9	57	K9	22	N9	8
B10		E10	20	H10	48	K10	35	N10	4
B11		E11	20	H11	26	K11	15	N11	
B12		E12	18	H12	12	K12	22	N12	
B13		E13	6	H13	16	K13	7	N13	
B14		E14	4	H14	20	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	5	L2		O2	
C3		F3	13	I3	17	L3		O3	
C4		F4	18	I4	14	L4	9	O4	
C5	6	F5	25	I5	41	L5	38	O5	
C6	13	F6	48	I6	62	L6	36	O6	
C7	4	F7	50	I7	63	L7	15	O7	
C8	16	F8	25	I8	56	L8	13	O8	
C9	12	F9	48	I9	66	L9	10	O9	
C10	6	F10	37	I10	54	L10	13	O10	
C11		F11	15	I11	26	L11	16	O11	
C12		F12	15	I12	12	L12	9	O12	
C13		F13	17	I13	18	L13		O13	
C14		F14	12	I14	11	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(B3): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-BR	Temp (°C)	Initial	28.0
Pressure (kg/cm²)	1.00		Final	29.0
Replication	R2	Rel. Hum (%)	Initial	90.0
Duration (hr)	1.00		Final	90.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	6	J2	7	M2	
A3		D3		G3	14	J3	16	M3	
A4		D4	5	G4	19	J4	12	M4	
A5		D5	14	G5	31	J5	22	M5	4
A6		D6	17	G6	64	J6	46	M6	22
A7		D7	21	G7	77	J7	79	M7	20
► A8		D8	18	G8	89	J8	58	M8	14
A9		D9	14	G9	49	J9	52	M9	19
A10		D10	22	G10	41	J10	43	M10	14
A11		D11	11	G11	12	J11	17	M11	9
A12		D12	5	G12	17	J12	12	M12	
A13		D13		G13	8	J13	16	M13	
A14		D14		G14	16	J14	4	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	7	K2		N2	
B3		E3	4	H3	14	K3	6	N3	
B4		E4	18	H4	21	K4	9	N4	
B5		E5	12	H5	55	K5	19	N5	
B6		E6	11	H6	48	K6	18	N6	11
B7	7	E7	28	H7	54	K7	39	N7	10
B8	4	E8	16	◻ H8		K8	32	N8	9
B9	5	E9	14	H9	52	K9	26	N9	7
B10		E10	19	H10	41	K10	14	N10	7
B11		E11	17	H11	32	K11	13	N11	
B12		E12	21	H12	14	K12	26	N12	
B13		E13	7	H13	15	K13	4	N13	
B14		E14	5	H14	12	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	7	L2		O2	
C3		F3	9	I3	18	L3		O3	
C4		F4	14	I4	12	L4	12	O4	
C5	5	F5	28	I5	45	L5	14	O5	
C6	8	F6	52	I6	59	L6	15	O6	
C7	7	F7	49	I7	67	L7	16	O7	
C8	18	F8	27	I8	58	L8	11	O8	
C9	11	F9	44	I9	69	L9	8	O9	
C10	5	F10	41	I10	48	L10	14	O10	
C11		F11	12	I11	24	L11	13	O11	
C12		F12	18	I12	11	L12	12	O12	
C13		F13	15	I13	22	L13		O13	
C14		F14	10	I14	10	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(B4): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-BR	Temp (°C)	Initial	26.0
Pressure (kg/cm²):	1.00		Final:	27.5
Replication:	R3	Rel. Hum (%)	Initial	92.0
Duration (hr).	1.00		Final	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	7	J2	8	M2	
A3		D3		G3	15	J3	15	M3	
A4		D4	4	G4	16	J4	14	M4	
A5		D5	11	G5	37	J5	28	M5	7
A6		D6	18	G6	61	J6	19	M6	19
A7		D7	20	G7	84	J7	81	M7	24
► A8		D8	22	G8	81	J8	62	M8	11
A9		D9	17	G9	46	J9	44	M9	16
A10		D10	24	G10	39	J10	38	M10	12
A11		D11	10	G11	18	J11	21	M11	8
A12		D12	4	G12	13	J12	15	M12	
A13		D13		G13	12	J13	12	M13	
A14		D14		G14	11	J14	10	M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	12	K2		N2	
B3		E3	5	H3	11	K3	7	N3	
B4		E4	16	H4	19	K4	5	N4	
B5		E5	10	H5	57	K5	21	N5	
B6		E6	37	H6	41	K6	17	N6	9
B7	7	E7	29	H7	62	K7	42	N7	8
B8	5	E8	14	◻ H8		K8	28	N8	12
B9	5	E9	14	H9	54	K9	24	N9	9
B10		E10	21	H10	38	K10	17	N10	4
B11		E11	13	H11	39	K11	16	N11	
B12		E12	27	H12	12	K12	28	N12	
B13		E13	5	H13	19	K13	12	N13	
B14		E14	4	H14	7	K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2	6	L2		O2	
C3		F3	8	I3	17	L3		O3	
C4		F4	11	I4	13	L4	9	O4	
C5	7	F5	24	I5	48	L5	16	O5	
C6	6	F6	58	I6	55	L6	12	O6	
C7	6	F7	45	I7	64	L7	18	O7	
C8	21	F8	23	I8	59	L8	12	O8	
C9	12	F9	42	I9	58	L9	6	O9	
C10	5	F10	36	I10	52	L10	11	O10	
C11		F11	11	I11	27	L11	17	O11	
C12		F12	22	I12	10	L12	10	O12	
C13		F13	14	I13	26	L13		O13	
C14		F14	4	I14	11	L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◻ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(85): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-BR	Temp. (°c)	Initial:	30.0
Pressure (kg/cm²):	1.25		Final:	29.0
Replication:	R1	Rel. Hum. (%)	Initial:	85.5
Duration (hr):	1.00		Final:	87.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	7	J2	5	M2	
A3		D3	4	G3	15	J3	13	M3	
A4		D4	10	G4	16	J4	12	M4	4
A5		D5	17	G5	39	J5	19	M5	6
A6		D6	19	G6	61	J6	47	M6	16
A7		D7	19	G7	84	J7	58	M7	17
► A8		D8	12	G8	135	J8	58	M8	15
A9		D9	20	G9	41	J9	55	M9	19
A10		D10	20	G10	46	J10	40	M10	15
A11		D11	16	G11	25	J11	26	M11	6
A12		D12	10	G12	11	J12	18	M12	
A13		D13		G13	15	J13	19	M13	
A14		D14		G14	19	J14	11	M14	
A15		D15		G15	7	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	7	K2		N2	
B3		E3	10	H3	15	K3	10	N3	
B4		E4	15	H4	20	K4	15	N4	
B5		E5	18	H5	48	K5	14	N5	
B6		E6	30	H6	53	K6	22	N6	9
B7		E7	37	H7	41	K7	33	N7	17
B8	5	E8	16	☼ H8		K8	34	N8	19
B9	6	E9	37	H9	54	K9	32	N9	13
B10		E10	30	H10	45	K10	18	N10	4
B11		E11	21	H11	27	K11	18	N11	
B12		E12	18	H12	10	K12	17	N12	
B13		E13	12	H13	13	K13	9	N13	
B14		E14		H14	21	K14		N14	
B15		E15		H15	9	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	4	I2	6	L2		O2	
C3		F3	14	I3	14	L3	4	O3	
C4	4	F4	15	I4	15	L4	11	O4	
C5	10	F5	25	I5	42	L5	15	O5	
C6	15	F6	49	I6	63	L6	16	O6	
C7	8	F7	64	I7	60	L7	15	O7	4
C8	14	F8	30	I8	44	L8	12	O8	4
C9	18	F9	50	I9	58	L9	15	O9	
C10	12	F10	44	I10	58	L10	16	O10	
C11	5	F11	25	I11	38	L11	16	O11	
C12		F12	18	I12	16	L12	7	O12	
C13		F13	17	I13	18	L13		O13	
C14		F14	13	I14	21	L14		O14	
C15		F15		I15	6	L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(86): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-BR	Temp. (°c)	Initial:	28.0
Pressure (kg/cm²):	1.25		Final:	28.5
Replication:	R2	Rel. Hum. (%)	Initial:	91.0
Duration (hr):	1.00		Final:	90.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	8	J2	4	M2	
A3		D3	4	G3	16	J3	11	M3	
A4		D4	10	G4	12	J4	15	M4	6
A5		D5	12	G5	39	J5	26	M5	9
A6		D6	21	G6	54	J6	38	M6	11
A7		D7	18	G7	86	J7	62	M7	27
► A8		D8	14	G8	128	J8	57	M8	14
A9		D9	16	G9	41	J9	49	M9	20
A10		D10	29	G10	52	J10	33	M10	15
A11		D11	10	G11	31	J11	29	M11	5
A12		D12	15	G12	16	J12	18	M12	
A13		D13		G13	15	J13	22	M13	
A14		D14		G14	12	J14	8	M14	
A15		D15		G15	9	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	7	K2		N2	
B3		E3	4	H3	14	K3	6	N3	
B4		E4	15	H4	21	K4	13	N4	
B5		E5	19	H5	59	K5	14	N5	
B6		E6	38	H6	43	K6	28	N6	9
B7	5	E7	30	H7	36	K7	37	N7	16
B8	4	E8	16	☼ H8		K8	29	N8	22
B9	4	E9	38	H9	50	K9	32	N9	11
B10		E10	24	H10	47	K10	17	N10	4
B11		E11	22	H11	28	K11	12	N11	
B12		E12	14	H12	17	K12	16	N12	
B13		E13	17	H13	11	K13	8	N13	
B14		E14		H14	14	K14		N14	
B15		E15		H15	6	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	4	I2	4	L2		O2	
C3		F3	12	I3	13	L3	5	O3	
C4	4	F4	15	I4	16	L4	14	O4	
C5	6	F5	28	I5	34	L5	11	O5	
C6	18	F6	64	I6	72	L6	18	O6	
C7	10	F7	79	I7	58	L7	14	O7	4
C8	14	F8	34	I8	35	L8	19	O8	4
C9	12	F9	56	I9	62	L9	12	O9	
C10	15	F10	29	I10	46	L10	15	O10	
C11	6	F11	20	I11	28	L11	16	O11	
C12		F12	16	I12	19	L12	4	O12	
C13		F13	15	I13	14	L13		O13	
C14		F14	5	I14	14	L14		O14	
C15		F15		I15	7	L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(87): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-BR	Temp. (°c)	Initial:	27.5
Pressure (kg/cm²):	1.25		Final:	28.5
Replication:	R3	Rel. Hum. (%)	Initial:	91.0
Duration (hr):	1.00		Final:	89.5
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	8	J2	4	M2	
A3		D3	4	G3	16	J3	11	M3	
A4		D4	10	G4	12	J4	15	M4	6
A5		D5	12	G5	39	J5	26	M5	9
A6		D6	21	G6	54	J6	38	M6	11
A7		D7	18	G7	86	J7	62	M7	27
► A8		D8	14	G8	128	J8	57	M8	14
A9		D9	16	G9	41	J9	49	M9	20
A10		D10	29	G10	52	J10	33	M10	15
A11		D11	10	G11	31	J11	29	M11	5
A12		D12	15	G12	16	J12	18	M12	
A13		D13		G13	15	J13	22	M13	
A14		D14		G14	12	J14	8	M14	
A15		D15		G15	9	J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	7	K2		N2	
B3		E3	4	H3	14	K3	6	N3	
B4		E4	15	H4	21	K4	13	N4	
B5		E5	19	H5	59	K5	14	N5	
B6		E6	38	H6	43	K6	28	N6	9
B7	5	E7	30	H7	36	K7	37	N7	16
B8	4	E8	16	☼ H8		K8	29	N8	22
B9	4	E9	38	H9	50	K9	32	N9	11
B10		E10	24	H10	47	K10	17	N10	4
B11		E11	22	H11	28	K11	12	N11	
B12		E12	14	H12	17	K12	16	N12	
B13		E13	17	H13	11	K13	8	N13	
B14		E14		H14	14	K14		N14	
B15		E15		H15	6	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	4	I2	4	L2		O2	
C3		F3	12	I3	13	L3	5	O3	
C4	4	F4	15	I4	16	L4	14	O4	
C5	6	F5	28	I5	34	L5	11	O5	
C6	18	F6	64	I6	72	L6	18	O6	
C7	10	F7	79	I7	58	L7	14	O7	4
C8	14	F8	34	I8	35	L8	19	O8	4
C9	12	F9	56	I9	62	L9	12	O9	
C10	15	F10	29	I10	46	L10	15	O10	
C11	6	F11	20	I11	28	L11	16	O11	
C12		F12	16	I12	19	L12	4	O12	
C13		F13	15	I13	14	L13		O13	
C14		F14	5	I14	14	L14		O14	
C15		F15		I15	7	L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(88): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	D-BR	Temp. (°c)	Initial	26.5
Pressure (kg/cm²):	1.50		Final	27.5
Replication:	R1	Rel. Hum. (%)	Initial.	92.0
Duration (hr):	1.00		Final.	91.0
Wind Data:	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	4	J2	6	M2	
A3		D3		G3	14	J3	13	M3	
A4		D4	8	G4	25	J4	18	M4	5
A5		D5	16	G5	51	J5	31	M5	12
A6		D6	21	G6	68	J6	54	M6	16
A7		D7	22	G7	90	J7	62	M7	19
► A8		D8	10	G8	115	J8	59	M8	19
A9		D9	23	G9	49	J9	62	M9	19
A10		D10	18	G10	50	J10	49	M10	15
A11		D11	17	G11	27	J11	20	M11	10
A12		D12	14	G12	12	J12	22	M12	4
A13		D13	5	G13	16	J13	15	M13	
A14		D14		G14	13	J14	15	M14	
A15		D15		G15	8	J15	7	M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	6	K2	4	N2	
B3		E3	8	H3	15	K3	11	N3	
B4		E4	15	H4	32	K4	16	N4	
B5		E5	20	H5	52	K5	29	N5	5
B6	4	E6	34	H6	61	K6	38	N6	22
B7		E7	39	H7	66	K7	94	N7	18
B8		E8	12	☼ H8		K8	53	N8	11
B9	4	E9	42	H9	39	K9	40	N9	13
B10	4	E10	33	H10	53	K10	22	N10	6
B11		E11	19	H11	34	K11	16	N11	4
B12		E12	18	H12	10	K12	15	N12	
B13		E13	16	H13	13	K13	13	N13	
B14		E14	4	H14	17	K14	7	N14	
B15		E15	4	H15	12	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	4	I2	6	L2		O2	
C3		F3	12	I3	15	L3	5	O3	
C4		F4	19	I4	23	L4	12	O4	
C5	9	F5	36	I5	42	L5	15	O5	
C6	15	F6	58	I6	63	L6	18	O6	
C7	12	F7	68	I7	62	L7	22	O7	8
C8	8	F8	30	I8	66	L8	21	O8	4
C9	19	F9	54	I9	70	L9	18	O9	4
C10	16	F10	49	I10	71	L10	15	O10	
C11	11	F11	24	I11	34	L11	16	O11	
C12	4	F12	19	I12	12	L12	10	O12	
C13		F13	20	I13	13	L13	6	O13	
C14		F14	12	I14	20	L14		O14	
C15		F15	4	I15	11	L15		O15	
C16		F16		I16		L16		O16	

(Note: ☼ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(89): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-BR	Temp (°C)	Initial:	29.5
Pressure (kg/cm²)	1.50		Final:	28.5
Replication	R2	Rel. Hum. (%)	Initial:	88.5
Duration (hr)	1.00		Final:	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	5	J2	5	M2	
A3		D3		G3	11	J3	11	M3	
A4		D4	6	G4	29	J4	21	M4	4
A5		D5	15	G5	54	J5	35	M5	13
A6		D6	24	G6	72	J6	51	M6	17
A7		D7	23	G7	85	J7	68	M7	18
► A8		D8	12	G8	124	J8	54	M8	15
A9		D9	27	G9	42	J9	61	M9	21
A10		D10	26	G10	43	J10	52	M10	11
A11		D11	11	G11	31	J11	12	M11	9
A12		D12	13	G12	11	J12	15	M12	4
A13		D13	7	G13	18	J13	16	M13	
A14		D14		G14	14	J14	11	M14	
A15		D15		G15	9	J15	4	M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	6	K2	6	N2	
B3		E3	5	H3	11	K3	12	N3	
B4		E4	16	H4	37	K4	14	N4	
B5		E5	18	H5	48	K5	22	N5	6
B6		E6	12	H6	57	K6	37	N6	10
B7	4	E7	44	H7	72	K7	105	N7	19
B8		E8	11	◘ H8		K8	56	N8	15
B9	4	E9	39	H9	48	K9	38	N9	18
B10	6	E10	36	H10	54	K10	20	N10	4
B11		E11	18	H11	37	K11	24	N11	4
B12		E12	21	H12	21	K12	12	N12	
B13		E13	17	H13	12	K13	14	N13	
B14		E14	5	H14	14	K14	9	N14	
B15		E15	6	H15	11	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	5	I2	7	L2		O2	
C3		F3	11	I3	18	L3	8	O3	
C4		F4	22	I4	27	L4	11	O4	
C5	7	F5	30	I5	36	L5	17	O5	
C6	16	F6	61	I6	69	L6	12	O6	
C7	14	F7	59	I7	67	L7	24	O7	7
C8	4	F8	32	I8	58	L8	23	O8	5
C9	12	F9	55	I9	91	L9	15	O9	4
C10	21	F10	42	I10	68	L10	11	O10	
C11	9	F11	27	I11	41	L11	11	O11	
C12	8	F12	16	I12	10	L12	8	O12	
C13		F13	18	I13	16	L13	7	O13	
C14		F14	10	I14	19	L14		O14	
C15		F15	9	I15	10	L15		O15	
C16		F16		I16		L16		O16	

(Note: ◘ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(90): Catch-can data (Amount of water obtained in catch-cans)

Emitter	D-BR	Temp (°C)	Initial	28.0
Pressure (kg/cm²)	1.50		Final	29.0
Replication	R3	Rel. Hum. (%)	Initial	90.0
Duration (hr).	1.00		Final	89.0
Wind Data	No wind (closed indoors)			

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2	7	J2	12	M2	
A3		D3		G3	16	J3	10	M3	
A4		D4	4	G4	24	J4	24	M4	5
A5		D5	12	G5	69	J5	32	M5	10
A6		D6	26	G6	82	J6	54	M6	19
A7		D7	19	G7	86	J7	67	M7	21
► A8		D8	13	G8	117	J8	55	M8	12
A9		D9	28	G9	24	J9	69	M9	17
A10		D10	24	G10	56	J10	48	M10	12
A11		D11	10	G11	28	J11	16	M11	10
A12		D12	15	G12	15	J12	11	M12	4
A13		D13	6	G13	13	J13	22	M13	
A14		D14		G14	16	J14	9	M14	
A15		D15		G15	12	J15	5	M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2	7	K2	6	N2	
B3		E3	7	H3	12	K3	14	N3	
B4		E4	14	H4	39	K4	16	N4	
B5		E5	22	H5	44	K5	27	N5	7
B6	7	E6	28	H6	62	K6	38	N6	9
B7		E7	36	H7	78	K7	94	N7	14
B8		E8	15	◘ H8		K8	53	N8	19
B9	5	E9	28	H9	56	K9	39	N9	12
B10	4	E10	37	H10	82	K10	22	N10	5
B11		E11	10	H11	42	K11	18	N11	4
B12		E12	9	H12	18	K12	17	N12	
B13		E13	28	H13	10	K13	9	N13	
B14		E14	4	H14	12	K14	4	N14	
B15		E15	4	H15	9	K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2	6	I2	12	L2		O2	
C3		F3	12	I3	14	L3	5	O3	
C4		F4	28	I4	28	L4	14	O4	
C5	8	F5	24	I5	39	L5	13	O5	
C6	11	F6	72	I6	72	L6	19	O6	
C7	13	F7	48	I7	62	L7	28	O7	4
C8	7	F8	36	I8	54	L8	16	O8	4
C9	11	F9	24	I9	102	L9	14	O9	6
C10	18	F10	57	I10	55	L10	10	O10	
C11	12	F11	22	I11	34	L11	12	O11	
C12	5	F12	14	I12	17	L12	4	O12	
C13		F13	11	I13	14	L13	4	O13	
C14		F14	19	I14	23	L14		O14	
C15		F15	5	I15	8	L15		O15	
C16		F16		I16		L16		O16	

(Note: ◘ denotes emitter, ► denotes direction of the frame of the emitter towards that point)

Appendix IV(91): Catch-can data (Amount of water obtained in catch-cans)

Emitter	JFPP	Temp (°C)	Initial:	27.0
Pressure (kg/cm²)	3.00		Final:	28.0
Replication	-	Rel. Hum. (%)	Initial	89.0
Duration (hr)	1.00		Final	89.0
Cacth-can grid	150 cm spacing	Wind Data	1.77 km/hr N → S (1 hr net)	

GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)	GRID POINT	CATCH (ml)
A1		D1		G1		J1		M1	
A2		D2		G2		J2		M2	
A3		D3		G3		J3		M3	
A4		D4		G4	6	J4		M4	
A5		D5		G5	18	J5	8	M5	
A6		D6		G6	65	J6	33	M6	
A7		D7	8	G7	33	J7	42	M7	
A8		D8	11	G8	22	J8	40	M8	
A9		D9	8	G9	33	J9	135	M9	
A10		D10		G10	35	J10	60	M10	
A11		D11		G11	19	J11	22	M11	
A12		D12		G12		J12		M12	
A13		D13		G13		J13		M13	
A14		D14		G14		J14		M14	
A15		D15		G15		J15		M15	
A16		D16		G16		J16		M16	
B1		E1		H1		K1		N1	
B2		E2		H2		K2		N2	
B3		E3		H3		K3		N3	
B4		E4		H4	6	K4		N4	
B5		E5		H5	24	K5		N5	
B6		E6	19	H6	28	K6	14	N6	
B7		E7	29	H7	26	K7	26	N7	
B8		E8	28	◘ H8		K8	32	N8	
B9		E9	24	H9	10	K9	35	N9	
B10		E10	14	H10	34	K10	26	N10	
B11		E11		H11	29	K11	8	N11	
B12		E12		H12	8	K12		N12	
B13		E13		H13		K13		N13	
B14		E14		H14		K14		N14	
B15		E15		H15		K15		N15	
B16		E16		H16		K16		N16	
C1		F1		I1		L1		O1	
C2		F2		I2		L2		O2	
C3		F3		I3		L3		O3	
C4		F4		I4	6	L4		O4	
C5		F5	13	I5	14	L5		O5	
C6		F6	62	I6	34	L6		O6	
C7		F7	103	I7	28	L7	8	O7	
C8		F8	45	I8	22	L8	9	O8	
C9		F9	38	I9	20	L9	7	O9	
C10		F10	37	I10	80	L10	6	O10	
C11		F11	8	I11	25	L11		O11	
C12		F12		I12	8	L12		O12	
C13		F13		I13		L13		O13	
C14		F14		I14		L14		O14	
C15		F15		I15		L15		O15	
C16		F16		I16		L16		O16	

(Note: ◘ denotes the floppy sprinkler)

Appendix IV(92): Catch-can data (Amount of water obtained in catch-cans)

Emitter:	JFPP	Temp. (°C)	Initial	-
Pressure (kg/cm²):	-		Final:	-
Replication:	-	Rel. Hum. (%)	Initial	-
Duration (hr):	-		Final:	-
Cacth-can grid.	150 cm spacing	Wind Data.		

Remarks:

The test result has not taken into consideration, since the emitter does not perform well during the test

Appendix V: Kruskal-Wallis Test (One-way analysis of variance)

For the Kruskal-Wallis test, the values of a variable are transformed to ranks (ignoring group membership) to test that there is no shift in the center of the groups (that is, the centers do not differ). This is the nonparametric analog of a one-way analysis of variance.

Analysis of emitters - LOW pressure group

Categorical values encountered during processing are,
EMITTER (3 levels): ALBL, D-BR, D-NG

1. Dependent variable : CUC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	90.5
D-BR	9	90.0
D-NG	9	197.5

Kruskal-Wallis Test Statistic = 13.533
Probability is 0.001 assuming Chi-square distribution with 2 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of CUC differ significantly).

2. Dependent variable : COV
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	166.0
D-BR	9	162.0
D-NG	9	50.0

Kruskal-Wallis Test Statistic = 15.295
Probability is 0.000 assuming Chi-square distribution with 2 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of COV differ significantly).

3. Dependent variable : DC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	75.0
D-BR	9	138.0
D-NG	9	165.0

Kruskal-Wallis Test Statistic = 7.528
Probability is 0.023 assuming Chi-square distribution with 2 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, there is significant difference between centers of the values of DC).

4. Dependent variable : MAX%
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	127.000
D-BR	9	191.000
D-NG	9	60.000

Kruskal-Wallis Test Statistic = 15.136
Probability is 0.001 assuming Chi-square distribution with 2 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of MAX% differ significantly).

Analysis of emitters - MEDIUM pressure group

Categorical values encountered during processing are,
EMITTER (5 levels): ALGR, JNBK, JNBL, JNGR, JNWH

1. Dependent variable : CUC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALGR	9	295.5
JNBK	9	91.5
JNBL	9	195.0
JNGR	9	217.0
JNWH	9	236.0

Kruskal-Wallis Test Statistic = 14.338
Probability is 0.006 assuming Chi-square distribution with 4 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of CUC differ significantly).

2. Dependent variable : COV
Grouping variable : EMITTER

Group	Count	Rank Sum
ALGR	9	136.5
JNBK	9	269.5
JNBL	9	239.5
JNGR	9	212.5
JNWH	9	177.0

Kruskal-Wallis Test Statistic = 6.998
Probability is 0.136 assuming Chi-square distribution with 4 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of COV differ significantly).

3. Dependent variable : DC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALGR	9	183.5
JNBK	9	222.0
JNBL	9	281.5
JNGR	9	185.0
JNWH	9	163.0

Kruskal-Wallis Test Statistic = 5.636
Probability is 0.228 assuming Chi-square distribution with 4 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, there is significant difference between centers of the values of DC).

4. Dependent variable : MAX%
Grouping variable : EMITTER

Group	Count	Rank Sum
ALGR	9	244.5
JNBK	9	121.0
JNBL	9	217.5
JNGR	9	246.0
JNWH	9	206.0

Kruskal-Wallis Test Statistic = 6.723
Probability is 0.151 assuming Chi-square distribution with 4 df

The test rejects the hypothesis that there is no shift in the center of the groups (that is, the centers of the values of MAX% differ significantly).

Analysis of emitters - HIGH pressure group

Categorical values encountered during processing are,
EMITTER (2 levels): ALRD, D-LG

The procedure of the analysis was not suitable for this group since the number of levels of categorical values (EMITTER) were only 2. The test generally fails since the degree of freedom reduces to 1. But the Chi-square approximation suggests that in all the four tests, the centre of the values of the dependent variables (CUC, COV, DC and MAX%) do differ significantly, corresponding to the categorical values.

Analysis of all the emitters tested

Since two of the emitters couldn't be analysed with the Kruskal-Wallis test, the procedure was repeated for all the emitters (including ALRD and D-LG of the HIGH pressure group) tested in the present study, to investigate whether the hypothesis: centre of the values of the parameters used to describe the performance of the various emitters equal, is accepted.

Kruskal-Wallis One-Way Analysis of Variance for 90 cases

Categorical values encountered during processing are,

EMITTER (10 levels): ALBL, ALGR, ALRD, D-BR, D-LG, D-NG, JNBK, JNBL, JNGR, JNWH

1. Dependent variable : CUC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	527.5
ALGR	9	434.5
ALRD	9	651.0
D-BR	9	550.0
D-LG	9	54.0
D-NG	9	746.5
JNBK	9	164.5
JNBL	9	318.5
JNGR	9	312.0
JNWH	9	336.5

Kruskal-Wallis Test Statistic = 67.682
Probability is 0.000 assuming Chi-square distribution with 9 df
"The hypothesis is rejected"

2. Dependent variable : COV
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	306.0
ALGR	9	383.5
ALRD	9	268.5
D-BR	9	247.5
D-LG	9	764.0
D-NG	9	51.0
JNBK	9	581.5
JNBL	9	535.5
JNGR	9	511.5
JNWH	0	446.0

Kruskal-Wallis Test Statistic = 60.060
Probability is 0.000 assuming Chi-square distribution with 9 df
"The hypothesis is rejected"

3. Dependent variable : DC
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	494.0
ALGR	9	354.0
ALRD	9	619.0
D-BR	9	639.0
D-LG	9	90.5
D-NG	9	696.0
JNBK	9	186.5
JNBL	9	354.0
JNGR	9	358.0
JNWH	9	304.0

Kruskal-Wallis Test Statistic = 58.168
Probability is 0.000 assuming Chi-square distribution with 9 df
"The hypothesis is rejected"

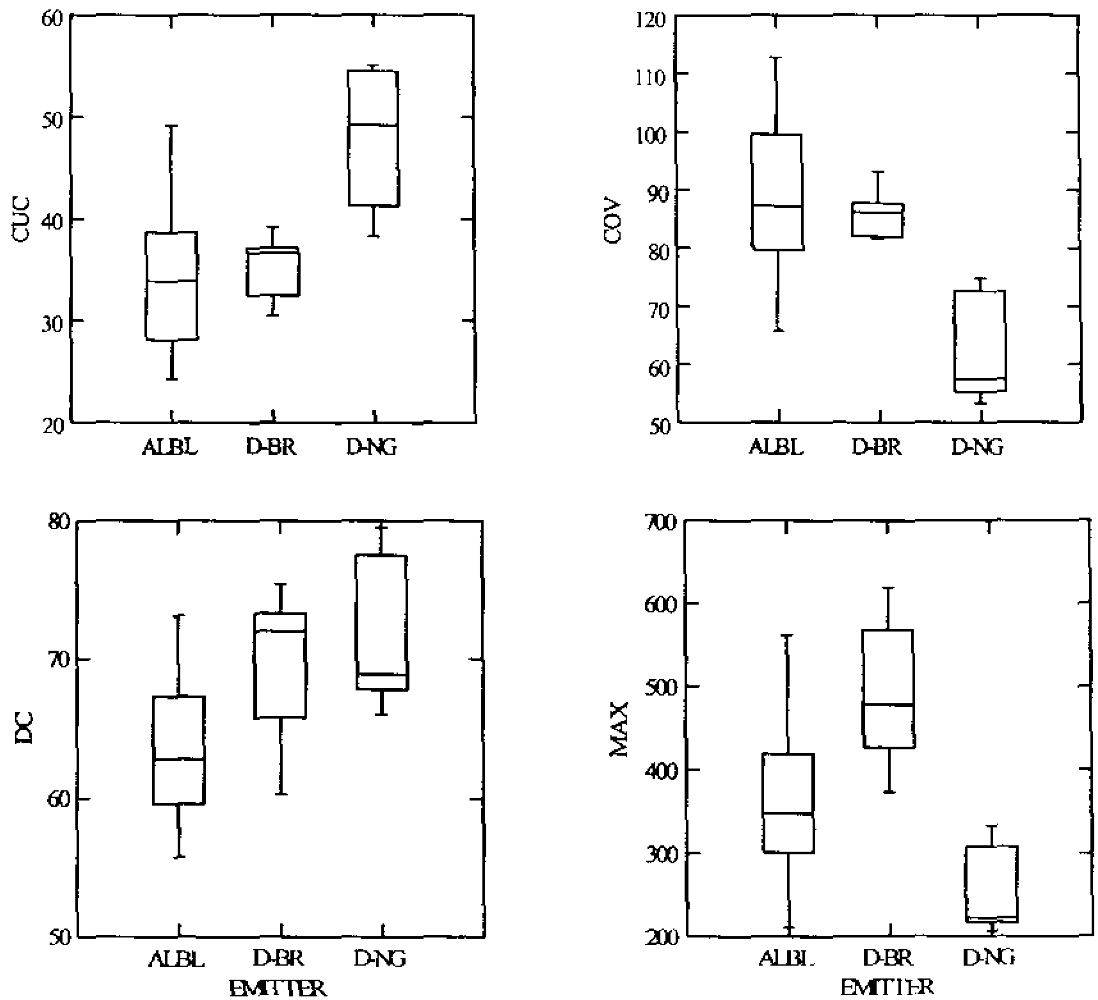
4. Dependent variable : MAX%
Grouping variable : EMITTER

Group	Count	Rank Sum
ALBL	9	249.5
ALGR	9	439.5
ALRD	9	234.0
D-BR	9	437.5
D-LG	9	722.0
D-NG	9	68.5
JNBK	9	506.0
JNBL	9	593.0
JNGR	9	447.5
JNWH	9	397.5

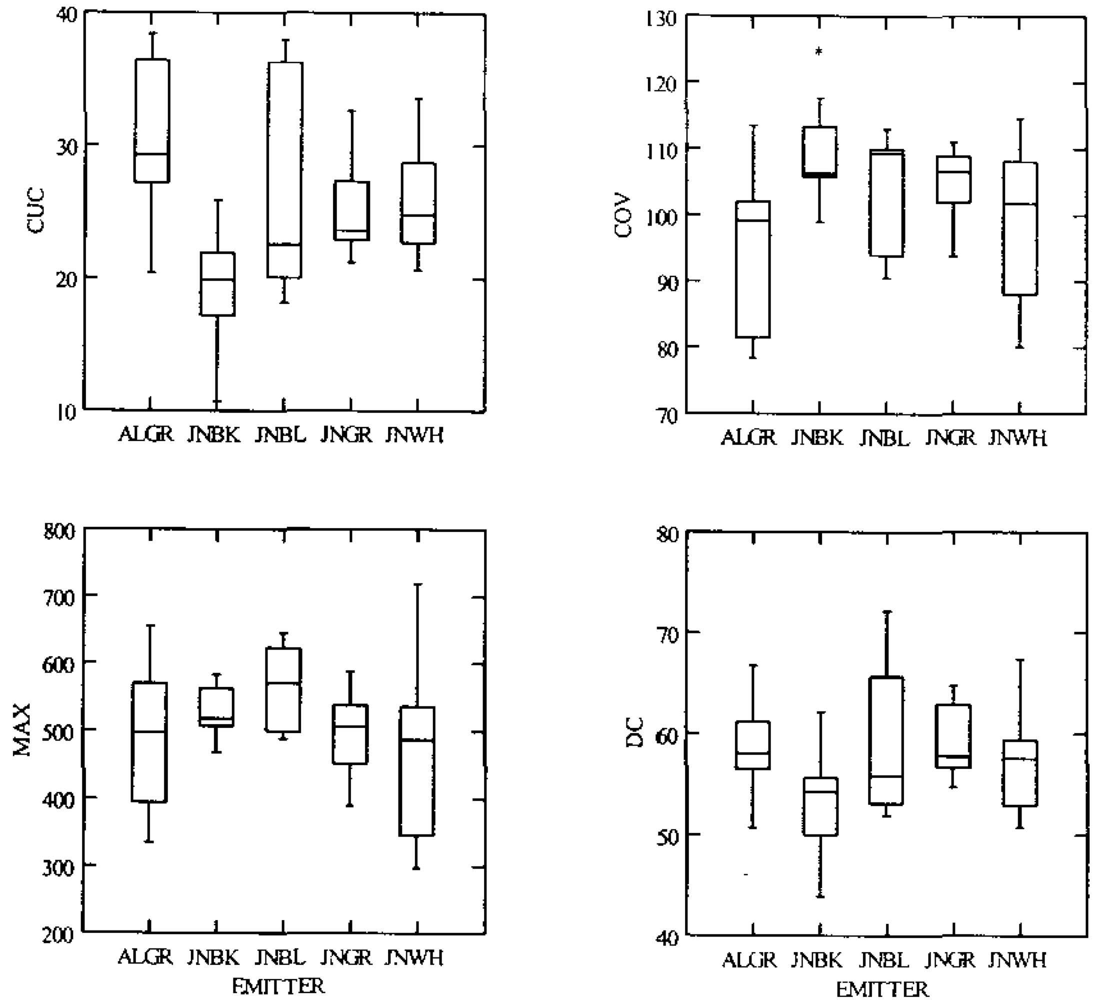
Kruskal-Wallis Test Statistic = 51.546
Probability is 0.000 assuming Chi-square distribution with 9 df
"The hypothesis is rejected"

The results of the tests given above clearly show that the performance of the emitters tested during the present study differ considerably among themselves. So it became necessary that some method or procedure should be adopted to identify the relative performance of the emitters; rather the emitters should be graded from SUPERIOR to the SECOND-RATED.

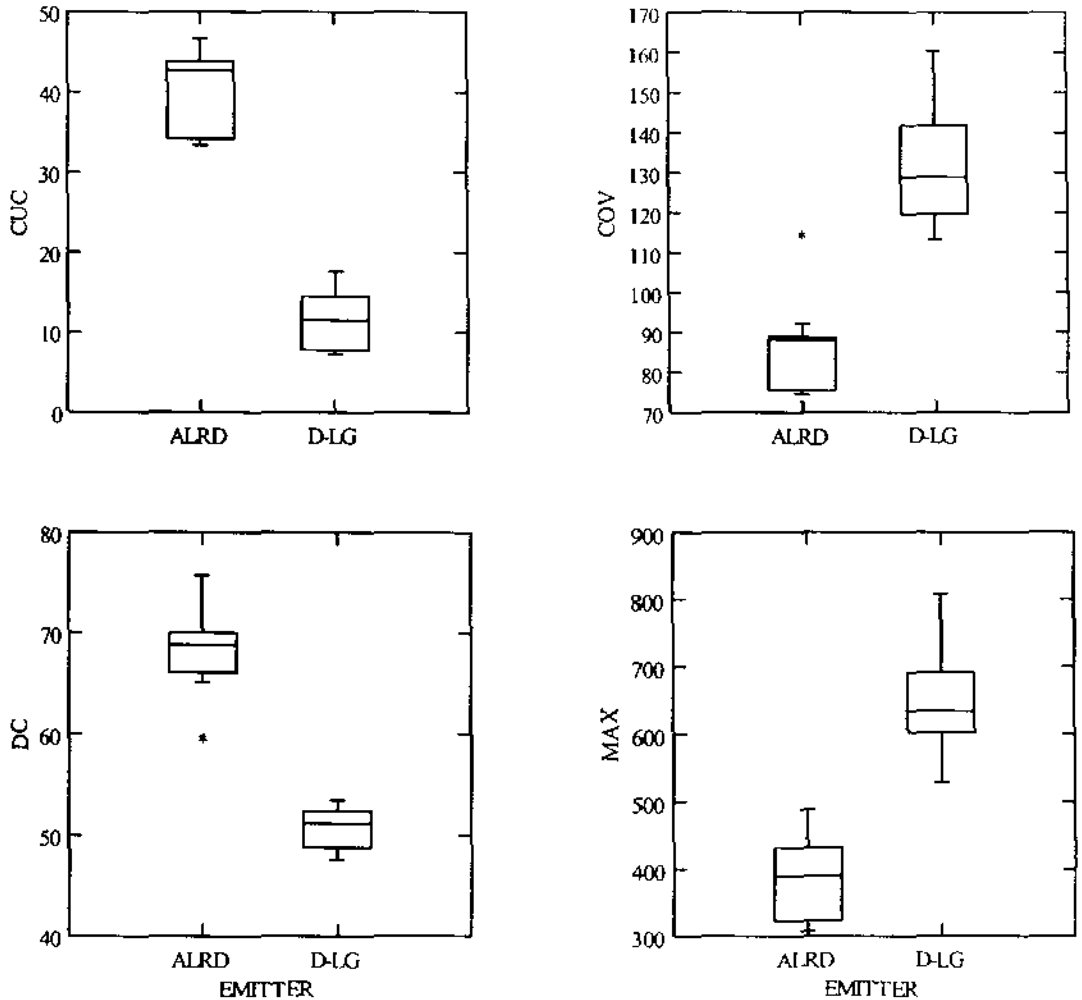
Appendix VI (1): Boxplot – Analysis of performance parameters of LOW pressure group of emitters



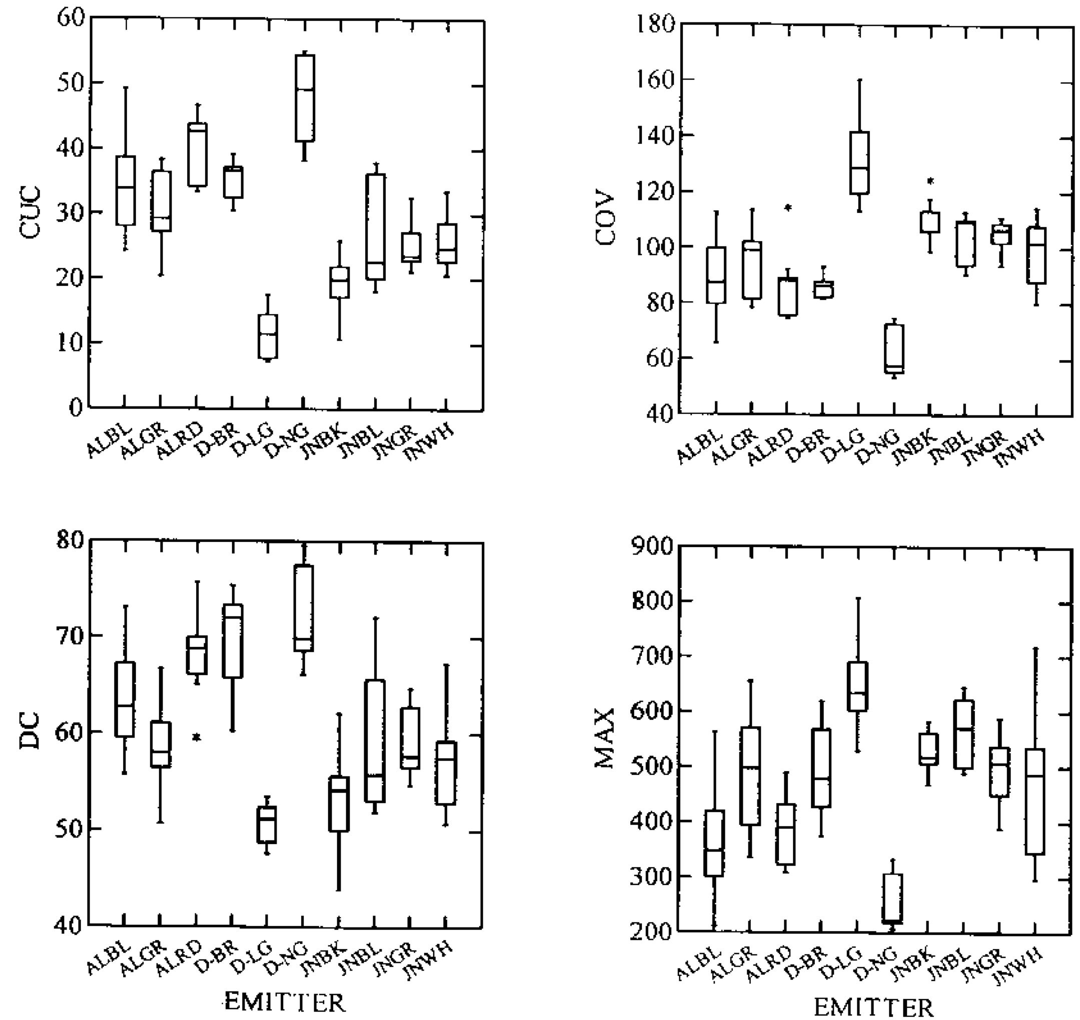
Appendix VI (2): Boxplot – Analysis of performance parameters of MEDIUM pressure group of emitters



Appendix VI (3): Boxplot – Analysis of performance parameters of HIGH pressure group of emitters



Appendix VI (4): BOX PLOT – Combined analysis of performance parameters of all the emitters



Appendix VII(1): Relative ranking of CUC of emitters

Emitter	Pressure (kg/cm^2)	Uniformity Coefficient, CUC			Ranks			Sum of CUCs	Rank of CUC sum	Total CUC sum	RANK
		R1	*R2*	*R3*	*k1*	*k2*	*k3*				
ALBL	*1.00*	49.2	42.7	38.0	3	4.5	6.5	129.9	5	310.4	***4***
	1.25	33.9	28.1	24.3	12	17	18	86.3	17		
	1.50	38.7	29.5	26.0	8	14	17	94.2	13		
ALGR	*1.00*	36.4	38.4	38.0	11	7	6.5	112.8	8	271.8	***5***
	1.50	29.3	28.2	29.6	17	16	14	87.1	16		
	2.00	27.2	24.3	20.4	18	19	23	71.9	19		
ALRD	*1.50*	46.7	47.3	46.8	4	3	3	140.8	3	368.8	***2***
	2.00	43.8	42.7	40.3	5	4.5	4	126.8	6		
	2.50	33.6	34.2	33.4	13.5	11	11	101.2	11		
JNBK	*1.00*	19.9	17.2	10.7	27	27	29	47.8	28	174.3	***9***
	1.50	25.9	21.7	16.5	19	22	27	64.1	24		
	2.00	21.9	22.2	18.3	25	21	25	62.4	25		
JNGR	*1.00*	32.6	31.4	27.3	15	13	15	91.3	15	227.8	***8***
	1.50	23.6	23.2	22.9	23	20	19	69.7	20		
	2.00	24.1	21.5	21.2	22	23	22	66.8	22		
JNWH	*1.00*	33.6	28.7	29.8	13.5	15	13	92.1	14	233.7	***7***
	1.50	24.8	24.7	26.8	20	18	16	76.3	18		
	2.00	22.7	20.6	22.0	24	24	21	65.3	23		
JNBL	*1.00*	38.0	36.3	37.4	9	10	8	111.7	9	237.0	***6***
	1.50	24.2	20.1	22.6	21	25	20	66.9	21		
	2.00	20.3	18.2	19.9	26	26	24	58.4	26		
D-NG	*1.00*	50.8	49.1	49.2	2	2	2	149.1	1	432.5	***1***
	1.25	54.9	54.5	38.3	1	1	5	147.7	2		
	1.50	41.3	39.3	55.1	6	6	1	135.7	4		
D-LG	*1.50*	7.5	7.8	7.3	30	30	30	22.6	30	106.1	***10***
	2.00	12.2	10.2	11.5	29	29	28	33.9	29		
	2.50	17.6	14.5	17.5	28	28	26	49.6	27		
D-BR	*1.00*	37.7	36.7	36.6	10	9	10	111.0	10	319.2	***3***
	1.25	39.2	37.2	37.2	7	8	9	113.6	7		
	1.50	32.5	31.6	30.5	16	12	12	94.6	12		

Appendix VII(2): Relative ranking of COV of emitters

Emitter	Pressure (kg/cm^2)	Coefficient of Variation, COV			Ranks			Sum of COVs	Rank of COV sum	Total COV sum	RANK
		R1	*R2*	*R3*	*k1*	*k2*	*k3*				
ALBL	*1.00*	65.7	73.2	87.3	3	3	9	226.2	4	803.9	*4*
	1.25	84.5	93.6	107.5	12	13	19	285.6	14		
	1.50	79.7	99.6	112.8	7	17	24	292.1	15		
ALGR	*1.00*	81.4	78.3	80.8	9	7	6	240.5	7	857.0	*5*
	1.50	94.2	99.1	100.1	17	16	14	293.4	17		
	2.00	107.6	102.0	113.5	23	18	27	323.1	22		
ALRD	*1.50*	74.7	75.2	77.7	5	5	5	227.6	5	722.1	*2*
	2.00	75.6	75.7	77.3	6	6	4	228.6	6		
	2.50	89.0	88.2	88.7	14	11	11	265.9	11		
JNBK	*1.00*	106.0	117.6	124.7	22	28	29	348.3	27	986.6	*9*
	1.50	98.9	105.8	113.3	18	19	26	318.0	19		
	2.00	104.1	106.3	109.9	21	20	22.5	320.3	21		
JNGR	*1.00*	93.7	97.2	102.2	16	15	16	293.1	16	937.8	*7*
	1.50	108.9	111.0	108.8	25	23	20	328.7	24		
	2.00	101.9	107.6	106.5	20	21	17	316.0	18		
JNWH	*1.00*	80.0	88.0	87.8	8	10	10	255.8	9	898.3	*6*
	1.50	101.7	114.6	101.7	19	26	15	318.0	19		
	2.00	109.1	108.1	107.3	26	22	18	324.5	23		
JNBL	*1.00*	90.5	93.9	92.7	15	14	12	277.1	13	938.9	*8*
	1.50	108.6	113.0	109.9	24	25	22.5	331.5	26		
	2.00	109.3	111.6	109.4	27	24	21	330.3	25		
D-NG	*1.00*	56.5	58.0	57.5	2	2	2	172.0	2	556.9	*1*
	1.25	54.5	55.3	53.4	1	1	1	163.2	1		
	1.50	72.6	74.3	74.8	4	4	3	221.7	3		
D-LG	*1.50*	150.0	160.4	141.9	30	30	30	452.3	30	1182.2	*10*
	2.00	128.9	129.1	122.9	29	29	28	380.9	29		
	2.50	119.6	116.2	113.2	28	27	25	349.0	28		
D-BR	*1.00*	81.6	82.1	81.8	10	8	7	245.5	8	773.1	*3*
	1.25	83.0	87.4	86.2	11	9	8	256.6	10		
	1.50	87.8	90.0	93.2	13	12	13	271.0	12		

Appendix VII(3): Relative ranking of DC of emitters

Emitter	Pressure (kg/cm^2)	Distribution Characteristic, DC			Ranks			Sum of	Rank of	Total	RANK
		R1	*R2*	*R3*	*k1*	*k2*	*k3*	DCs	DC sum	DC sum	
ALBL	*1.00*	73.1	67.3	67.3	5	8	6	207.7	7	570.6	***4***
	1.25	63.6	59.6	61.5	14	15	12	184.7	15		
	1.50	62.8	59.6	55.8	15.5	15	20.5	178.2	16		
ALGR	*1.00*	64.8	66.7	61.1	13	9	13	192.6	10	531.3	***7***
	1.50	56.3	57.8	59.4	22	19	16	173.5	19		
	2.00	58.0	56.5	50.7	20	21	26	165.2	23		
ALRD	*1.50*	75.7	71.4	70.0	2	4	4	217.1	3	613.3	***3***
	2.00	69.9	68.8	66.7	7.5	6	8	205.4	8		
	2.50	66.1	65.1	59.6	11	11	15	190.8	11		
JNBK	*1.00*	55.6	49.1	43.9	24.5	29	30	148.6	30	481.8	***9***
	1.50	62.1	59.3	54.2	17	17.5	22	175.6	17		
	2.00	55.4	52.2	50.0	26	25	27	157.6	26		
JNGR	*1.00*	62.8	64.7	62.9	15.5	12	10	190.4	12	532.0	***6***
	1.50	56.1	59.6	56.9	23	15	18	172.6	20		
	2.00	57.7	54.7	56.6	21	22	19	169.0	21		
JNWH	*1.00*	67.3	59.3	62.5	10	17.5	11	189.1	13	518.4	***8***
	1.50	59.2	57.5	57.5	18	20	17	174.2	18		
	2.00	52.9	50.7	51.5	28	27	25	155.1	27		
JNBL	*1.00*	72.1	65.6	70.5	6	10	3	208.2	6	535.6	***5***
	1.50	58.5	53.1	55.8	19	23	20.5	167.4	22		
	2.00	55.6	52.5	51.9	24.5	24	24	160.0	24		
D-NG	*1.00*	69.9	70.9	68.9	7.5	5	5	209.7	5	646.9	***1***
	1.25	77.5	77.7	79.5	1	1	1	234.7	1		
	1.50	67.8	68.6	66.1	9	7	9	202.5	9		
D-LG	*1.50*	52.4	50.0	47.6	29	28	29	150.0	28	457.0	***10***
	2.00	51.2	48.8	48.8	30	30	28	148.8	29		
	2.50	53.5	51.2	53.5	27	26	23	158.2	25		
D-BR	*1.00*	75.2	72.0	67.2	4	3	7	214.4	4	622.8	***2***
	1.25	75.4	73.3	72.6	3	2	2	221.3	2		
	1.50	65.8	61.0	60.3	12	13	14	187.1	14		

Appendix VII(4): Relative ranking of MAX% of emitters

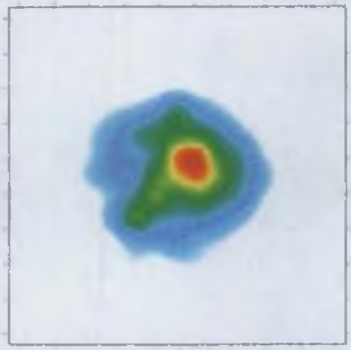
Emitter	Pressure (kg/cm^2)	MAX% *R1*	*R2*	*R3*	Ranks *k1*	*k2*	*k3*	Sum of MAX%'s	Rank of MAX% sum	Total MAX% sum	RANK
ALBL	*1.00*	287	301	211	3	3	1	799	3	3413	*2*
	1.25	348	419	562	9	12	23	1329	12		
	1.50	324	407	554	7	10	22	1285	11		
ALGR	*1.00*	343	335	394	8	7	8	1072	7	4399	*5*
	1.50	475	508	497	16	18	15	1480	15		
	2.00	655	622	570	28	26	25	1847	27		
ALRD	*1.50*	432	451	489	13	13	13.5	1372	13	3485	*3*
	2.00	318	308	323	6	4	5	949	4		
	2.50	390	379	395	11	8	9	1164	8		
JNBK	*1.00*	481	562	520	18	21	18	1563	20	4716	*8*
	1.50	468	507	518	14.5	17	17	1493	17		
	2.00	509	568	583	20	22	27	1660	21		
JNGR	*1.00*	389	418	451	10	11	10	1258	10	4468	*7*
	1.50	574	588	538	24	24	19	1700	23		
	2.00	468	535	507	14.5	20	16	1510	19		
JNWH	*1.00*	297	331	346	4	5	6	974	6	4248	*4*
	1.50	514	719	542	21	29	20	1775	26		
	2.00	536	487	476	22	14	11	1499	18		
JNBL	*1.00*	497	500	489	19	15	13.5	1486	16	5077	*9*
	1.50	571	576	546	23	23	21	1693	22		
	2.00	623	645	630	26	28	29	1898	28		
D-NG	*1.00*	207	222	223	1	1	3	652	1	2282	*1*
	1.25	216	239	217	2	2	2	672	2		
	1.50	316	334	308	5	6	4	958	5		
D-LG	*1.50*	691	808	603	29	30	28	2102	30	5821	*10*
	2.00	703	642	634	30	27	30	1979	29		
	2.50	633	529	578	27	19	26	1740	24		
D-BR	*1.00*	427	395	374	12	9	7	1196	9	4426	*6*
	1.25	584	619	568	25	25	24	1771	25		
	1.50	476	505	478	17	16	12	1459	14		

Appendix VIII: Area of the distribution pattern at specified levels of Da

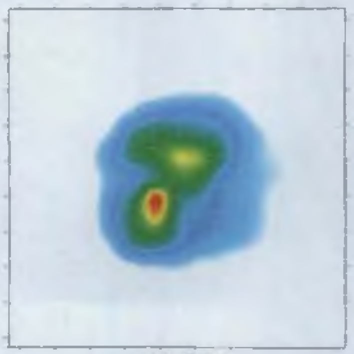
(Area of distribution pattern between specified contour levels, in cm^2)

Emitter	Pressure	Da	MAX%	Area corresponding to contour level range			
				10 - 50	50 -100	100 - 200	> 200
ALBL	1.00	0.13	287	68644	55613	61272	21540
	1.25	0.16	348	71883	52984	56082	26400
	1.50	0.18	324	74510	50108	50069	26271
ALGR	1.00	0.17	343	66525	62837	62573	18897
	1.50	0.2	475	89524	55753	56521	35149
	2.00	0.21	655	105369	60778	54476	36928
ALRD	1.50	0.4	432	67003	67755	104662	17611
	2.00	0.34	318	96437	98117	103912	40060
	2.50	0.31	390	121672	112824	87491	58846
JNBK	1.00	0.14	481	101999	49243	32616	32649
	1.50	0.16	468	106015	59575	36612	33927
	2.00	0.16	509	114359	56471	47750	35148
JNGR	1.00	0.14	389	77278	61394	38066	26420
	1.50	0.16	574	92008	56692	33718	34549
	2.00	0.17	468	92694	44203	33516	32927
JNWH	1.00	0.18	297	67624	44056	53647	27974
	1.50	0.17	514	111400	56377	52440	39500
	2.00	0.18	536	111540	55316	45402	38542
JNBL	1.00	0.19	497	150335	161154	96599	52133
	1.50	0.21	571	245866	125374	108206	72894
	2.00	0.23	623	220433	118999	129118	83789
D-NG	1.00	0.18	207	111345	123709	146879	25
	1.25	0.14	216	106634	119778	193995	2397
	1.50	0.14	316	140569	117684	138370	39814
D-LG	1.50	0.53	691	45363	45565	27528	21452
	2.00	0.51	703	40277	22824	50418	19918
	2.50	0.54	633	50973	26427	49355	21403
D-BR	1.00	0.16	427	126632	207290	65601	71113
	1.25	0.16	584	137978	211812	82946	71229
	1.50	0.17	476	169187	196234	81492	88285

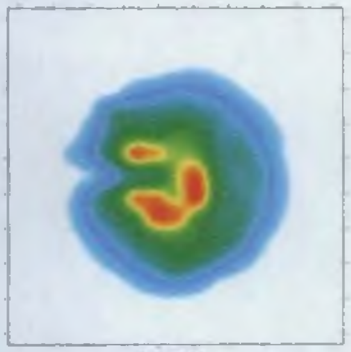
Appendix IX: CIT Densogram with colour shades



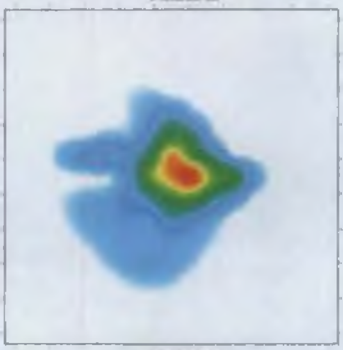
ALBL



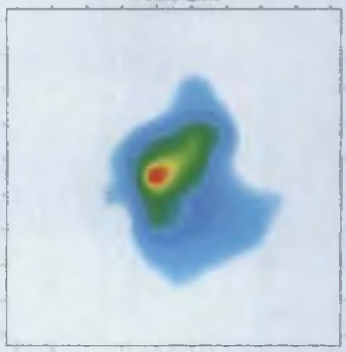
ALGR



ALRD



JNBK



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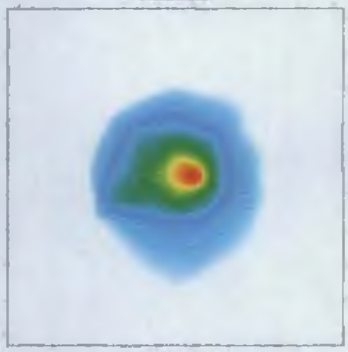
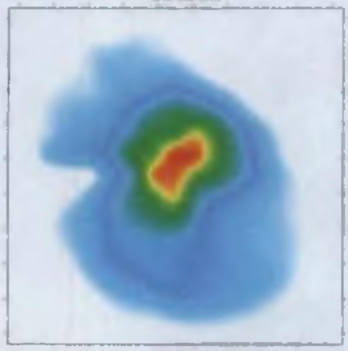


JNWH



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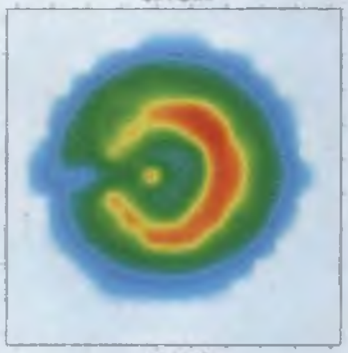
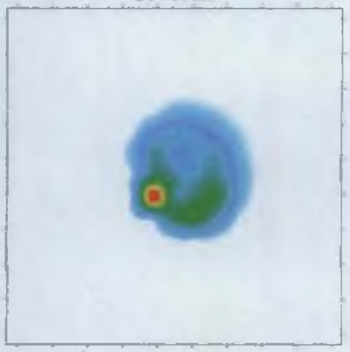
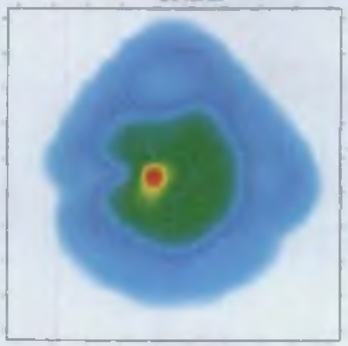


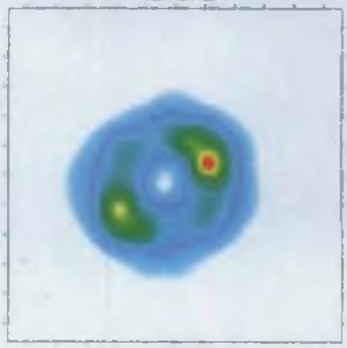
D-NG



D-LG



D-BR



JFPP

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PERFORMANCE EVALUATION OF MICRO-IRRIGATION DEVICES

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JACOB BIJO DANIEL

ABSTRACT OF THE THESIS

Submitted in partial fulfillment of the requirement for the degree

Master of Technology
in
Agricultural Engineering

Faculty of Agricultural Engineering
Kerala Agricultural University

Department of Land & Water Resources and

Conservation Engineering

KELAPPAJI COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY

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Abstract

Several micro-irrigation emitters were evaluated for their individual performance and were compared among themselves on the basis of different performance parameters, and the results were used to analyse the credibility of the claim of the manufacturers. The emitters were tested for their quality of the workmanship, uniformity of flow rate and for their distribution performance. A total of thirty micro-sprinklers (ten models in three replications) were evaluated. The distribution performance of each of the devices was described by different performance parameters. The performance parameters used for this purpose were uniformity coefficient, coefficient of variation, distribution characteristic etc. The distribution patterns (densograms) were drawn and carefully studied to analyse the nature of distribution performance of the emitters. The values of the performance parameters were used to grade the devices using different statistical and ranking tools. It is generally concluded that only the manufacturer data should not be taken into consideration while selecting the irrigation devices and from the farmers' point of view it is safer to depend more on the technical information resulting from scientific investigations.