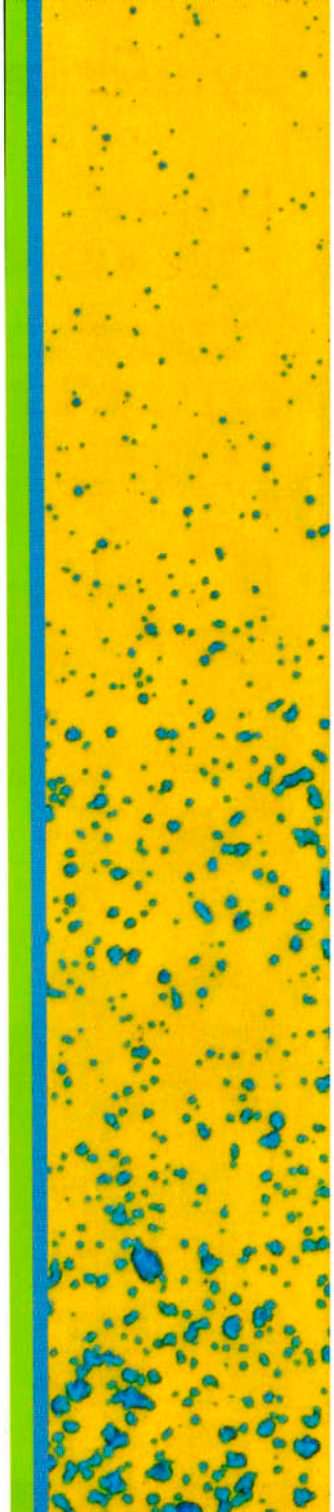
Water-sensitive paper
for monitoring spray distribution



Collector sizes

Water-sensitive papers are available in the following sizes and numbers:

Sizes in mm	Numbers of papers per alufoil bag	Recommended use
76x26	25	For aerial applications and airblast sprayers

order no.: 3100-0011
Quantity: 1 pack a 50 pieces - (2 alufoil bags)

Ordering

All orders should include customer number, buyer name and contact information and price quotation number, if applicable. Orders will be confirmed by a QInstruments representative prior to shipment.

Business Hours: 8:00 AM - 5:00 PM Europe Time
Phone: + 49 (0) 3641 - 87612-0
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Sales and Order: order@QInstruments.com
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Loebstedter Str. 101
Germany

The water-sensitive paper system has been developed for field use by Syngenta Crop Protection AG, CH-4002 Basel, Switzerland.

The water-sensitive paper is a product of Switzerland.

Droplet counting aid

Select window according to the droplet number, place it at random on the collector and count the droplets with the lens:

1 cm²
few
drops

½ cm²
many
drops

¼ cm²
great
number
of drops

1 cm² = 0.155 sq in
1 sq in = 6.425 cm²

Front side

Recommended droplet density in the target area

LV (aqueous) spraying
Use water-sensitive paper

number of droplets per cm²*	type of spray
20–30	insecticides
20–30	herbicides pre-emergence
30–40	contact herbicides post-emergence
50–70	fungicides

ULV (waterless) spraying
Use oil-sensitive paper

number of droplets per cm²*	target specifications
20–30	insecticides in the target area where the insects feed
50–70	horizontally above the canopy

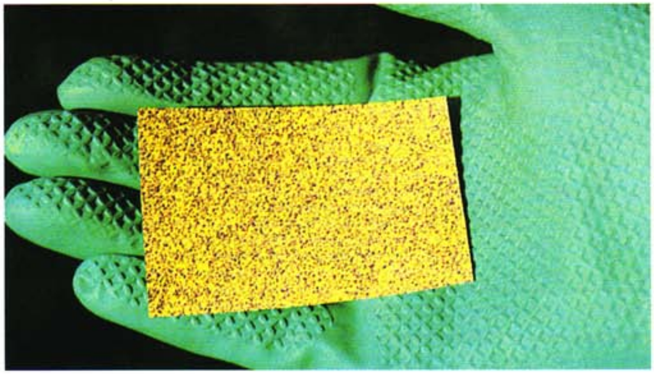
* 1 cm² = 0.155 sq inch 1 sq inch = 6.452 cm²

Rear side

What is water-sensitive paper?

Water-sensitive paper is a rigid paper with a specially coated, yellow surface which will be stained dark blue by aqueous droplets impinging on it. It has been developed for field use by Syngenta for the quick evaluation of LV sprays. For droplet assessment aqueous sprays no longer need the addition of dye. Just place the papers in the target area before spraying. Following exposure to the spray the water-sensitive papers will be stained. Retrieve the papers as soon as they have become dry. Check the droplet pattern. For a quick estimate compare the exposed collectors with a known standard or count the droplets either using a hand lens or an automatic image analyzer.

Water-sensitive paper before exposure to the spray.



Water-sensitive paper after exposure (courtesy Spraying Systems Co.).

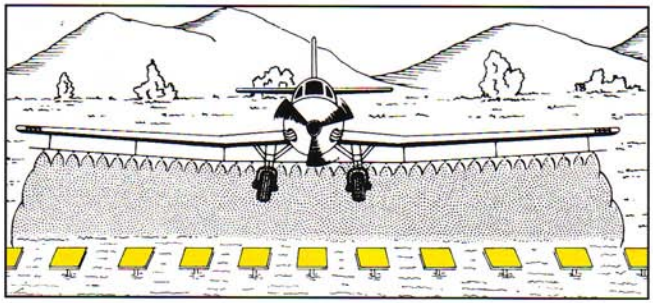
Where to use it

Water-sensitive paper can be used for checking spray distribution, droplet density from aerial and ground spray applications and droplet sizing.

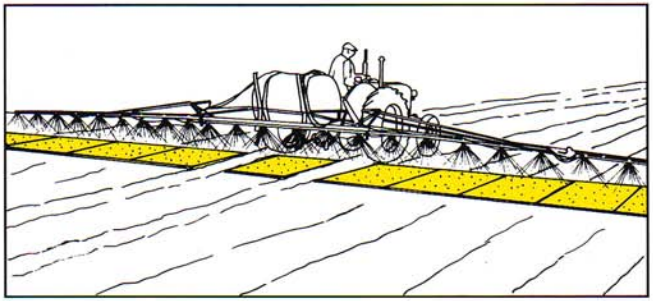
Overdosing is a waste of product. With herbicides it might result in crop damage and claims. With insecticides underdosing might not kill the pest. Calibrate the sprayer and check the spray pattern. Water-sensitive paper helps you to keep the environment clean.

Number the collectors consecutively before placing them on the supports. This will help you to spot irregularities in your spray system when evaluating the exposed cards.

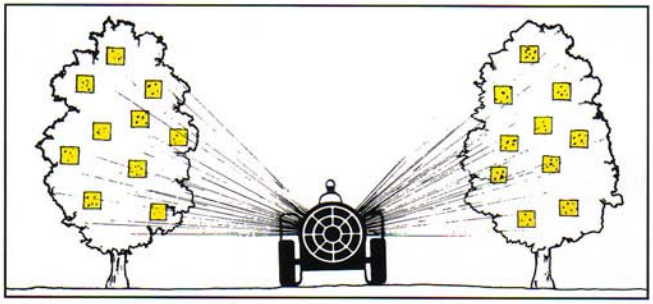
The correct boom height can also be determined with water-sensitive paper. Insufficient overlapping of the spray pattern can be corrected by raising the boom. Excessive overlapping is leveled out by lowering the boom.



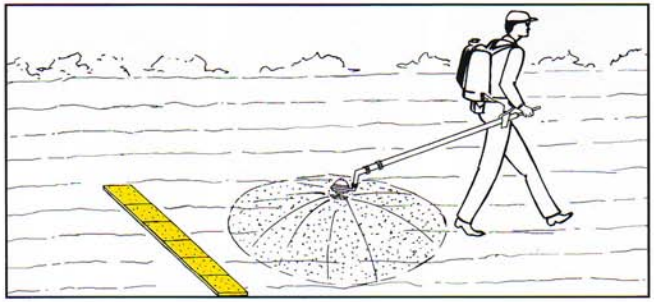
In aerial LV applications: place cards at 2 to 3 m intervals over three run widths. Fix cards on a rigid horizontal support slightly above the ground or just above the crop canopy.



Field sprayer applying LV sprays: staple water-sensitive paper onto a wooden lath and place it across a single run width. Leave gap for tractor wheels.



Airblast sprayers in orchards: staple water-sensitive paper directly onto leaves at the periphery and inside the canopy at the top, in the center and lower part of the trees.



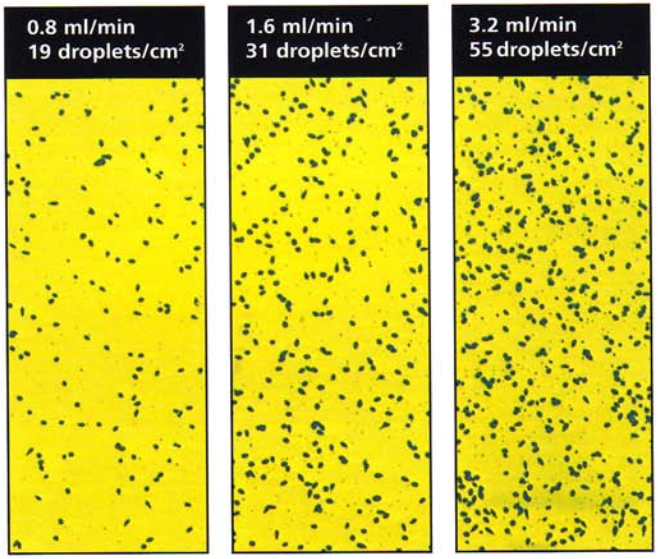
Operator equipped with a spinning disk sprayer suitable for herbicide applications at the rate of 20 to 30 liters per ha: staple water-sensitive papers on a lath and place it across a single run width.

How to evaluate spray deposits

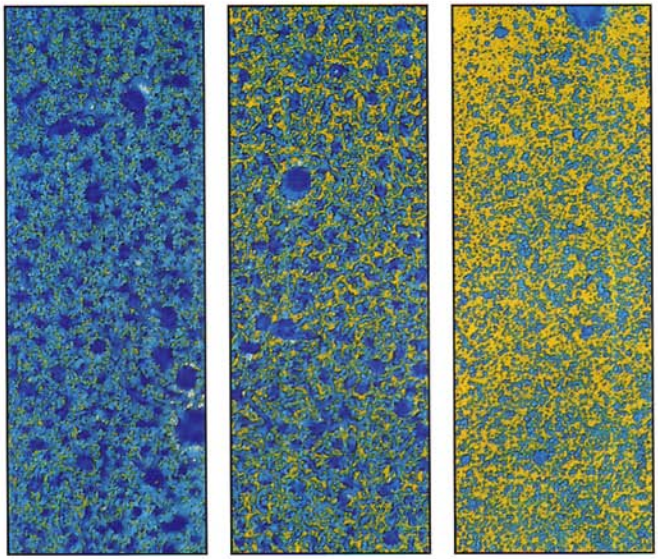
Spray cards can be evaluated either by visual estimate, by counting the droplets under a lens, or by automatic image analyzers such as the Optomax V.

Visual assessment of spray distribution

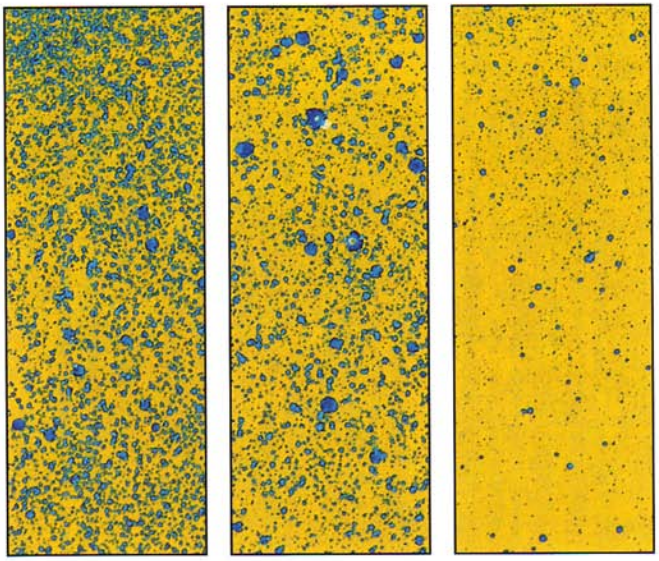
For a quick assessment place the numbered papers in front of you. A glance will reveal overdosing or underdosing originating from either incorrect nozzle settings or malfunctioning. Recording the spray pattern makes it easier to identify and correct any of these deficiencies. For accurate assessment of droplet density, counting is still recommended.



Droplet numbers produced with a spinning disk sprayer at 1800 rpm and 3 different flow rates (0.8, 1.6, 3.2 ml/min) producing a VMD of 300 µm.*



Water-sensitive papers exposed to aqueous sprays. A quick glance reveals positions of overdosing [above, left] and underdosing [opposite, right] and nozzle dripping (above).



**Volume median diameter (half the spray volume consist of droplets smaller, and half of it larger than the VMD)*

Visual assessment of droplet densities

Compare your spray samples with some known standard. The standard cards below and on the following page cover the range of acceptable droplet densities for coarse and medium LV spray. The droplet density in the target area should not be less than:

Numbers of droplets per cm²*	Type of spray
20–30	Insecticides
20–30	Herbicides pre-emergence
30–40	Contact herbicides post-emergence
50–70	Fungicides

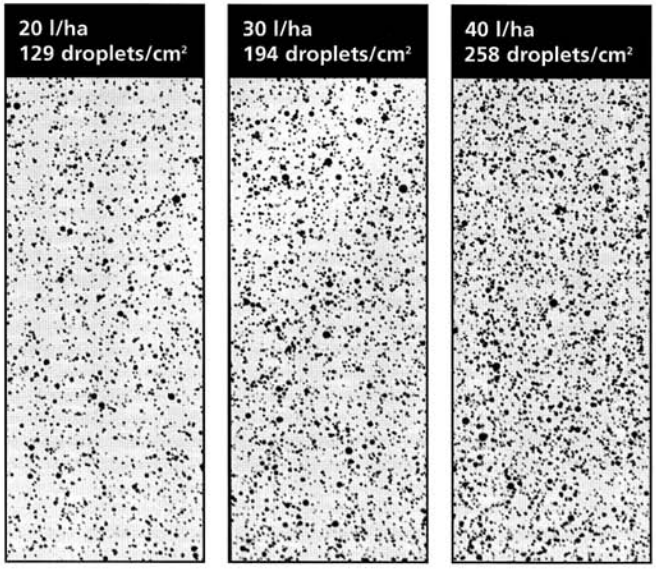
*1 cm² = 0.155 sq inch 1 sq inch = 6.452 cm²

For routine checking of sprays you might also prepare your own standard cards by selecting spray cards with known droplet densities from previous spray operations.

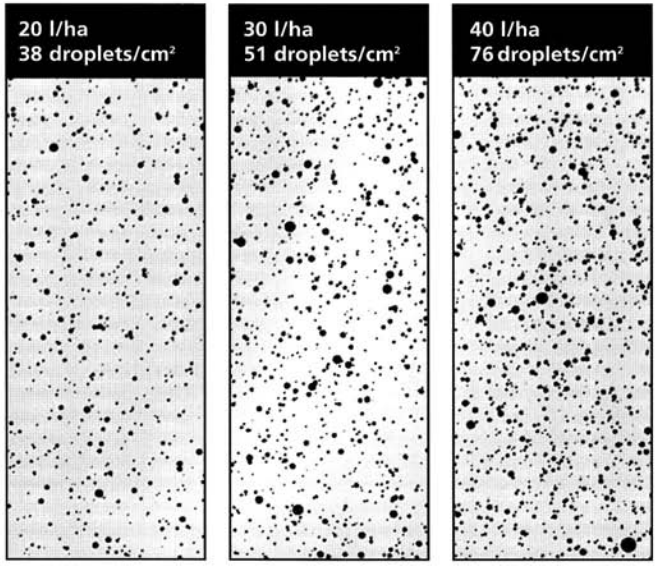
Standard cards with a known droplet density per cm²

Computer-plotted standard cards displaying the expected number and sizes cards spraying at 3 different volume rates (20, 30, 40 l/ha) and using 3 different droplet spectra (VMD, 200, 300, 400 µm) assuming waters sprayed and the spread factor is two (see page 11).

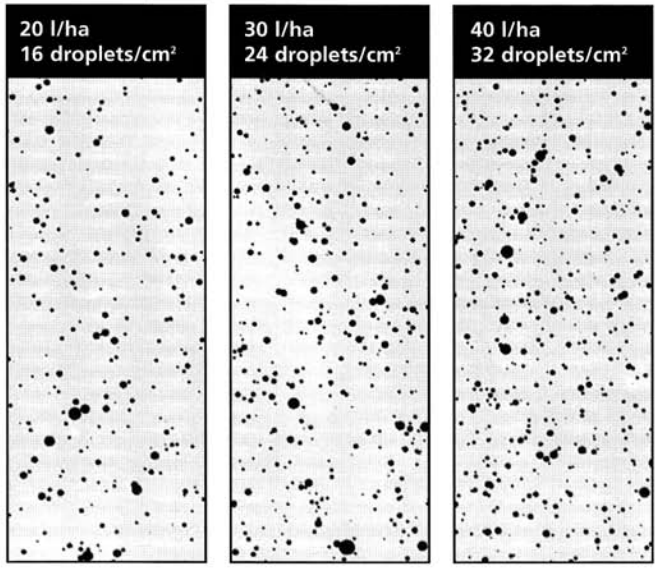
VMD 200 µm



VMD 300 µm



VMD 400 µm



Optical assessment of droplet densities

Linen tester lens together with the droplet counting aid card on an exposed collector paper.

For counting the droplets use a lens. Place it at random on the collector at four different spots. Count the number of droplets and record them. After calculating the average number of droplets per cm² of each collector, you then calculate the average droplet density for all the collector papers from a particular layout.
Water-sensitive papers are also suitable for processing in automatic image analyzers such as the Optomax V provided the droplet density is sufficiently small for the individual drops not to overlap with each other.

Optomax V automatic image analyzer processing collector papers at the Syngenta laboratory.

Droplet sizing

The water-sensitive paper can also be used for droplet sizing:

$$\frac{\text{stain diameter}}{\text{spread factor}} = \text{drop diameter}$$

Stain diameter of drops, in µm	Spread factor*	Drop diameter actual, in µm
100	1.7	59
200	1.8	109
300	1.9	155
400	2.0	200
500	2.1	243
600	2.1	285

**Refering to water at 20°C and about 40% relative humidity (RH), and droplets reaching the water-sensitive paper sedimentation velocity.*

The spread factors have been assessed by the magnesium oxide (1) and the silicon-oil method (2).

For droplet sizing Syngenta has created a glass insert with a view field of 1 cm², a cross graticule with notches at 200 µm (0.2 mm) spacing. It fits exactly into the metal frame of the linen tester lens depicted opposite. A more expensive tubular lens with notches at 100 µm spacing is also available. Its view field is 0.432 cm².

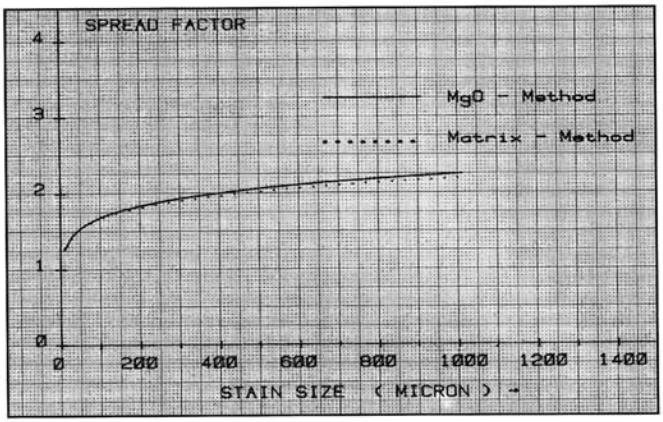
The relative humidity (%) and the pH on value of the water are of no major influence on spread factors on water-sensitive papers.

For accurate droplet sizing it is recommended that the spread factor be assessed for each spray liquid as it may vary with different concentrations of the same product.

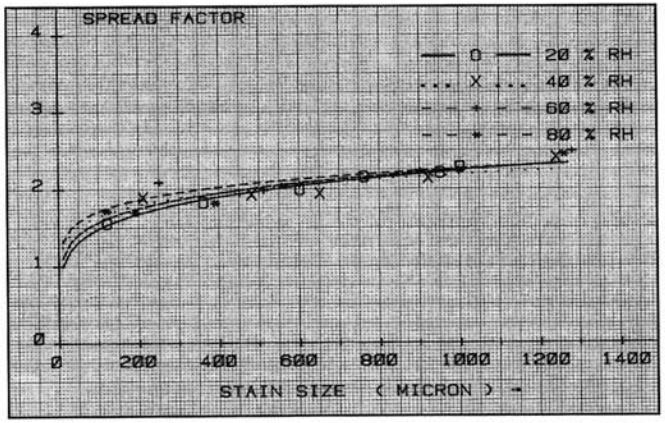
(1) The measurement of airborne droplets by the magnesium oxide method, K.R. May, Journal of Scientific Instruments 24, 128-130.

(2) Bestimmung und Bewertung von Tröpfchengrössenspektren bei Pflanzenschutzdrüsen, J. Jaske, Nachrichtenblatt des Deutschen Pflanzenschutzdienstes, 22.2.1970, 17-24.

Spread factor assessed at the temperature of 20°C in the laboratory



Spread factor of water on water-sensitive paper measured by the MgO and the silicon-oil method.



Spread factor of water on water-sensitive paper at different relative humidities (%):

— o — 20% RH --- + --- 60% RH
··· x ··· 40% RH --- * --- 80% RH

Biology and water-sensitive paper

Honeydew staining to evaluate the tobacco whitefly nymphs on cotton (1).

A laboratory method has been developed to estimate the number of surviving tobacco whitefly, *Bemisia tabaci* nymphs, after insecticide applications, based on the number of honeydew droplets ejected by nymphs in 30 minutes. Honeydew droplets excreted by live nymphs on water-sensitive paper stain blue and can easily be observed and counted. To estimate the number of live nymphs on an infested cotton leaf, the number of stains is divided by a factor of 1.29.

Honeydew stains of B. tabaci nymphs on water-sensitive paper.

Quantitative measurement

Water-sensitive paper has been used as a collector for active ingredients. Deposit amounts were measured after eluting them from the water-sensitive paper collectors by analytical methods (2).

(1) Phytoparasitica 12: 3-4, 1984, 157-161, 199-202.
(2) Use of water-sensitive paper to monitor the deposition of aerially applied insecticides. J. Econ. Entomol. (82, No. 3, 974-980, 1989).

Handling and storage

Handling

The paper collectors are laid out on artificial supports or stapled directly onto the leaves shortly before spraying takes place. Following exposure to the spray, the water-sensitive paper will be stained dark blue by aqueous droplets impinging on its coated surface. The stained papers must be retrieved as soon as be paid to the following points:

1. Gloves should be used (polyethylene or rubber) for handling the papers to avoid staining and contaminating the water-sensitive papers.
2. The collector support (natural or artificial) must be dry: the water-sensitive papers should not be laid out in the field while the plants are still wet from morning dew or rain.
3. The collector surface must not be scratched before use (collector rubbing against each other).
4. For better visibility of stains from WP or FW applications, the residual dry powder on top of the stains can easily be wiped off with dry paper tissues.

Storage and conservation

Shelflife: Water-sensitive papers packed in its original high-quality sealed alubags can be stored for 10 years and more, provided the sealing remains undamaged.

Water-sensitive collectors must be stored before and after spray exposure under dry conditions in airtight bags or boxes.

Exposed water-sensitive papers can also be protected with a colorless, thin adhesive foil. Avoid air pockets when applying the foil.

Aerosol sprays of colorless, synthetic resin can also be used. The pH value of the resin must be in the range of 4.5 to 6.0. Observe instructions for use when spraying with an aerosol can.

Limitations

Droplets counting by hand lens on water-sensitive paper is limited to a maximum of around 200 droplets per cm^2, equivalent to 50 to 200 liters per ha of medium to coarse sprays. At higher volumes the water-sensitive paper can still be used for rough visual assessment of spray distribution and/or crop penetration.

Requirements for measurements with automatic image analyzers: Accurate drop size measurements with the Optomax V Automatic Image Analyzer can only be made if the drop density is low enough for the majority of droplets not to overlap each other. The table below indicates the maximum drop density (n/cm^2) or volume rate (l/ha) which should not be exceeded for a given drop size for Optomax V measurements:

n/cm^2 max	l/ha max	VMD µm
600	12	100
200	24	200
80	33	300
50	48	400
30	55	500

The paper cannot be used under very humid conditions. Although it turns light blue at a relative humidity of 80% the stains produced by water droplets still show sufficient contrast to allow visual detection beyond this limit (mind finger prints).

It should not be used on humid or wet supports (e.g. early morning dew).

Cards should not be retrieved while the deposit is still wet.

Pure water stains the water-sensitive paper in drop sizes as small as 50 µm even at temperatures of T=50°C and relative humidity of 20%. However, in field trials under tropical conditions the water-sensitive paper may not show all the spray droplets which have impacted on it. This is due to evaporation increasing the concentration of the droplets so much that they contain very little or no water.

As a general rule aqueous spray droplets smaller than 100 µm should be avoided under topical conditions.

Water-sensitive paper may not always be suitable for use at temperatures below 10°C.