



A USER'S GUIDE TO DROPLET SIZE

TeeJet® Technologies

At **TeeJet Technologies** our primary focus is on application technology. Our company and products have been part of agricultural, turf, and right-of-way applications since the first crop protection products came on to the market in the 1940's. This knowledge and experience in the areas of spraying and fertilizing means no other company is better suited to provide quality products and technical solutions for your business.

Innovative, industry-leading products are what you expect from **TeeJet Technologies**. However, there is more to our company than great products. We also possess a wealth of technical information about applications and technologies that we wish to share.

Spray nozzles are highly engineered, precision components. Full consideration should be given to the manufacturer and the manufacturer's capabilities.



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Preface

A ***User's Guide To Droplet Size*** is an educational and informative resource that offers the most relevant and high-quality content related to droplet size. It provides facts, not opinions.

This first edition is intended for pesticide applicators, agronomists, and researchers, helping them refine their spray application techniques to achieve better efficacy and reduce environmental impact. The guide begins by emphasizing the critical role of droplet size in pesticide application. It then explains the concept of droplet size, followed by an overview of the industry standards and classifications used to categorize various droplet sizes. Lastly, it highlights the importance of identifying the ideal droplet size range for effective and responsible pesticide application, aligning with the goals of precision agriculture.

Through this guide, readers will gain practical insights that can aid in making informed decisions regarding droplet size, enhancing both productivity and sustainability in agricultural practices.

1.1 Introduction to Droplet Size

Spray technology is one of the most common processes in our daily lives and is very important across a spectrum of industries including petrochemicals, paper, steel, car wash, firefighting, spray painting, and agriculture. The meticulous management of droplet size and spray distribution is of utmost significance for achieving effective spray applications.

In the agricultural industry, particularly in pesticide application, the choice of a spray tip becomes a critical decision. It is important to select a spray tip that produces droplets of a size small enough to ensure adequate deposition and coverage on the target, yet large enough to prevent unintended drift away from the target area.

Over the past decade, there has been a significant increase in the availability of droplet size information. Advancements in the science and technology of atomization have seen tremendous progress, especially as spray applications have become more precise and the selection of the optimum droplet size range is required.

Droplet size plays a pivotal role in enhancing the effectiveness of crop protection products. This depends on several factors, including:



1) Type of crop protection product being used, its mobility within the plant, and the timing of application.



2) Specific target location.



3) Prevailing weather conditions.



4) Necessity for drift control, among other considerations.

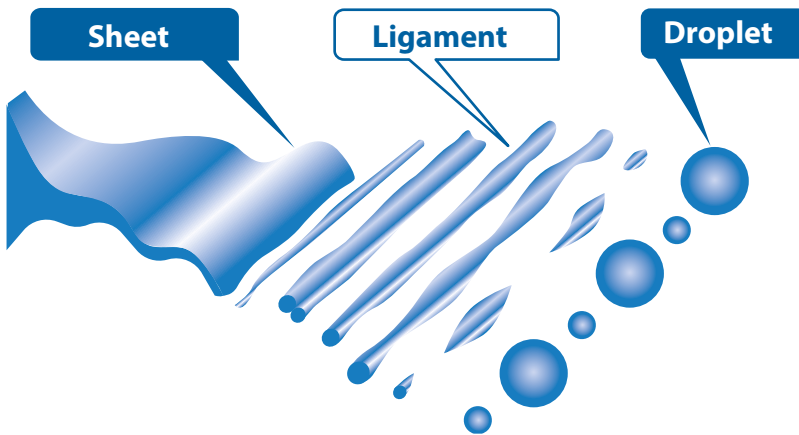
It is becoming crucial for agronomists and engineers to understand the fundamental atomization process and its evaluation.

2

Droplet Characteristics

2.1 Droplet Formation

Droplet size is a by-product of atomization¹⁻², which is a process that starts by pushing liquid through a spray tip or nozzle. The relation between the energy of the liquid and the shape of the tip leads to the formation of liquid ligaments. These ligaments subsequently fragment into even smaller parts known as droplets. Each spray provides a spectrum or range of droplet sizes; this range is referred to as a droplet size distribution.



Different spray tips feature distinct orifice shapes and create multiple spray patterns, including flat spray, hollow cone, full cone, solid stream, and more. The distribution of droplet size is dependent on the type of tip and can differ significantly. To achieve an accurate assessment of droplet size data, it is important to consider all key variables, including spray tip type, pressure, capacity, spray angle, liquid viscosity and surface tension. Additionally, a comprehensive understanding of the droplet size testing method is essential. The measurement techniques, type of droplet size analyzer, and methods for data analysis and reporting significantly impact the outcomes.








Multiple droplet size analyzers are available, with the majority of them relying on optical techniques for spray characterization. Optical methods can be broadly categorized into two main types: imaging (e.g., Oxford Laser) and non-imaging (e.g., Malvern Instruments Ltd and Sympatec GmbH). Optical analyzers are generally non-intrusive and do not disrupt the behavior of the spray during the testing process.



Droplet size analyzers gather and record data in a format that typically consists of a count of droplets within specific size classes. This data is then organized into a mathematical representation known as a droplet size distribution, and some parameters to evaluate the droplet size distribution can be obtained, such as $DV_{0.1}$, $DV_{0.5}$ (or VMD), $DV_{0.9}$, percentage of driftable fines, and relative span. These are defined in the next section 2.5.

2.2 Droplet size

Droplet size is determined by the diameter of a sprayed droplet. Droplet sizes are measured in microns (μm). A micron (1 μm) corresponds to 1/25,000 of an inch or about 0.001 mm. For perspective, the table below shows examples of known objects with their respective sizes in μm .

Objects		Relative Size (μm)
Point of a sewing needle		25
Human hair		100
Sewing thread		150
Toothbrush bristle		300
Staple		550
Paper clip wire		850
#2 Pencil lead		2,000

2.3 Droplet size distribution

Droplet size distribution is the distribution of droplets presented in a spray sample. The distribution is typically expressed by the droplet diameter versus the cumulative volume percentage³, as observed in the graphic on the next page.

The droplet size distribution will be dependent on the spray tip type, capacity, and operating pressure and will vary significantly from one type to another.

VF

F

M

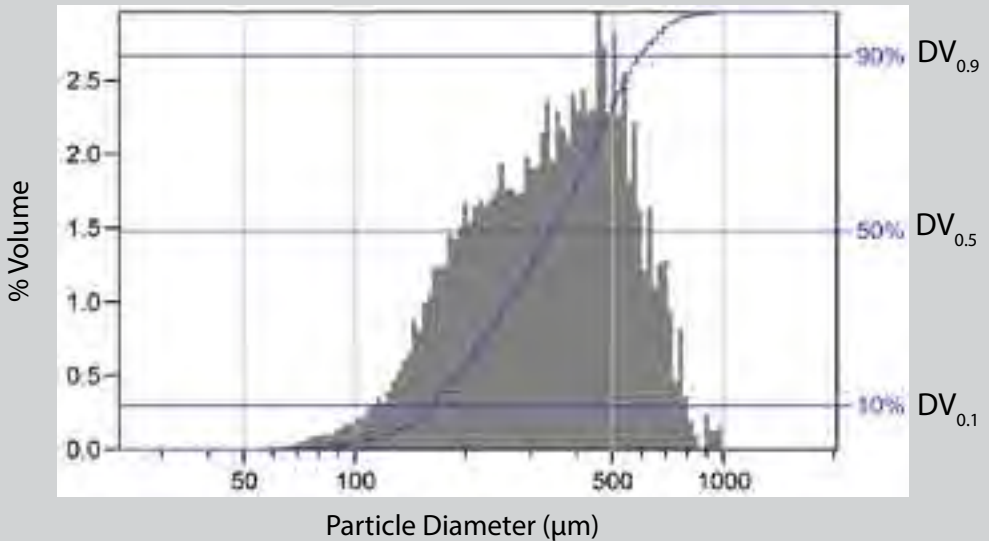
C

VC

XC

UC

Diameter Frequencies by Volume



Example of a graphic from an Oxford VisiSize report

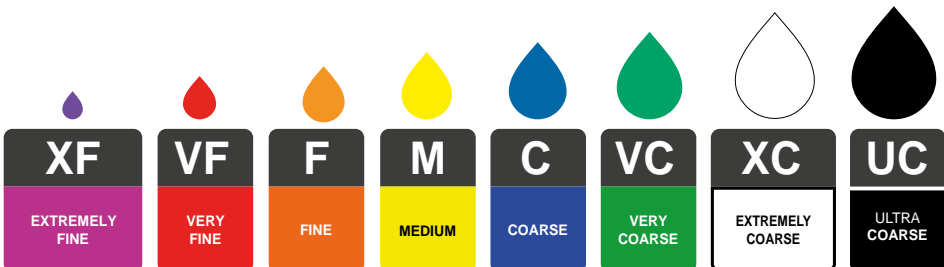
In Chapter 4, we will explore more examples of droplet size distribution in the most popular TeeJet® Technologies spray tips and understand in practice how this affects spray tip selection for different types of applications.

2.4 Droplet size classification standards

The droplet size classification follows a strict and concise standard, which was first created in 1985 in England by the British Crop Protection Council (BCPC). This classification system established a series of droplet size classes.

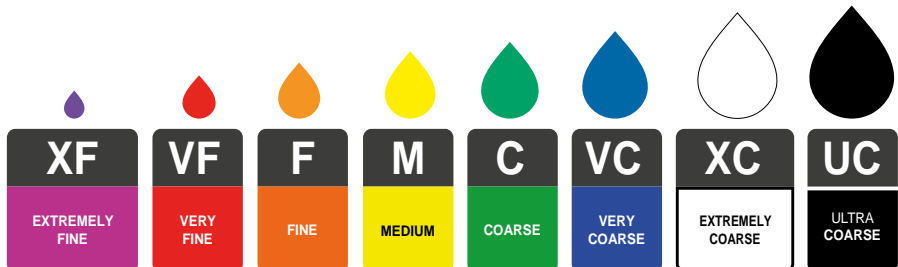
In 1999, the American Society of Agricultural and Biological Engineers (ASABE) developed a new standard for droplet size classification – ASABE S572, in which the droplet size boundaries were set by a series of defined TeeJet® Technologies reference tips and operating pressures (ASABE, 2009). The ASABE S572 original standard established six droplet size classes (VF, F, M, C, VC, and XC), with 5 reference tips establishing the boundaries between them. Two additional droplet size classes were added in the same year to the review of the standard – ASABE S572.1³, totaling eight classes (XF, VF, F, M, C, VC, XC, and UC). Each one of these classes were color-coded to easily identify the droplet size.

Color Coding - ASABE S572.1



The International Organization for Standardization (ISO) initiated the development of an international droplet size classification standard, and in 2018, the ISO 25358 standard was published (ISO, 2018)⁴. The changes added to the new standard included the update of certain droplet size classification ranges to distribute the classification boundaries more effectively. The major changes happen on the C/VC, VC/XC, and XC/UC boundaries. Subsequently, the ASABE has aligned its standard with ISO 25358, resulting in the updated ASABE S572.3⁴ standard. In these new standards, the color-coding for most droplet size classes has been retained. The only exception is observed in the Coarse and Very Coarse classes, where there is an inversion of colors. In ASABE S572.2, Coarse was denoted in blue, and Very Coarse was represented in green. However, under the new ISO25358/ASABE S572.3, Coarse is now represented in green, while Very Coarse is represented in blue.

Color Coding - ISO 25358/ ASABE S572.3



2.5

Droplet size parameters evaluated

To assess the droplet sizes produced by a spray tip, some measurements and parameters must be understood:

- **DV_{0.1}** - 10% of the cumulative volume diameter. The value where 10% of the total volume of liquid sprayed is made up of droplets with diameters smaller or equal to this value. For example, if the DV_{0.1} is listed as 100 μm, this means that only 10% of the volume of the spray is contained in droplets smaller than 100 μm (microns)*. The other 90% of the volume of the spray is contained in droplets larger than 100 μm.

- **DV_{0.5}** - 50% of the cumulative volume diameter or volume median diameter (VMD). The value where 50% of the total volume of liquid sprayed is made up of droplets with diameters larger than the median value and 50% smaller than the median value. For example, if the VMD is listed as 250 μm, this means that 50% of the volume of the spray is in droplets both larger and smaller than 250 μm.

- **DV_{0.9}** - 90% of the cumulative volume diameter. The value where 90% of the total volume of liquid sprayed is made up of droplets with diameters smaller or equal to this value. For example, if the DV_{0.9} is listed as 500 μm, this means that 90% of the volume of the spray is contained in droplets 500 μm or smaller. Only 10% of the volume is contained in droplets larger than 500 μm.

- **Driftable Fines droplets** is the percentage of droplets with a diameter smaller than 150 μm in an application volume.

- **Relative Span (RS)** – the parameter that indicates the droplet size uniformity distribution produced by a tip. The lower the RS value, the more homogeneous is the spray droplet spectrum. RS is calculated as demonstrated in the formula below.

$$\text{Relative Span (RS)} = \frac{DV_{0.9} - DV_{0.1}}{DV_{0.5}}$$

Example of RS of two tips:

TIP1

DV_{0.1} = 146 μm
 DV_{0.5} = 340 μm
 DV_{0.9} = 599 μm

Relative Span - RS = $\frac{DV_{0.9} - DV_{0.1}}{DV_{0.5}}$

$$RS = \frac{DV_{0.9} - DV_{0.1}}{DV_{0.5}} \rightarrow RS = \frac{599 - 146}{340} = 1.33$$

TIP2

DV_{0.1} = 144 μm
 DV_{0.5} = 340 μm
 DV_{0.9} = 467 μm

Relative Span - RS = $\frac{DV_{0.9} - DV_{0.1}}{DV_{0.5}}$

$$RS = \frac{DV_{0.9} - DV_{0.1}}{DV_{0.5}} \rightarrow RS = \frac{467 - 144}{340} = 0.95$$

In this example, TIP2 has a better RS than TIP1.

2.6 Factors affecting droplet size

2.6.1 Spray Tip Type

The different designs of spray tips available at TeeJet® will result in different droplet sizes. Here are the most common spray tip types used in agriculture:

Hollow cone: The hollow cone spray tip forms a circular-shaped pattern, producing very fine to fine droplets. These unique characteristics make hollow cone tips well suited for air-blast applications, as well as specialty and directed spray applications.

Flat fan: These are the most common type of tips used for broadcast, banding, and targeted spray applications. The droplet size produced by these tips depends on the tip design. Newer low drift flat fan spray tips feature three mechanisms to produce coarser droplets: a pre-orifice and/or Venturi air induction technology, or a recirculating chamber.

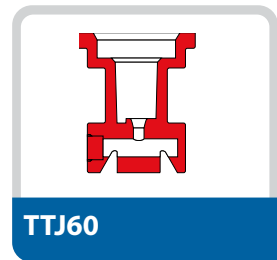
- **Pre-orifice flat fan spray tips** reduce the operating pressure internally and produce larger droplets than conventional flat fan spray tips. The tip's pre-orifice restricts the amount of liquid entering the tip and creates a pressure drop through the tip. Fewer droplets prone to drift are produced (creates excellent spray pattern uniformity). The examples of TeeJet® Technologies' low drift spray tips with a pre-orifice design are DG, TT, and TTJ60.



F M C
Fine Medium Coarse

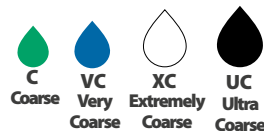
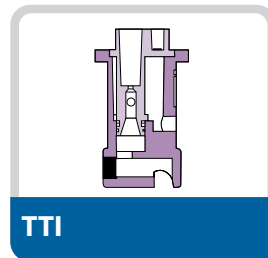
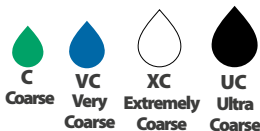
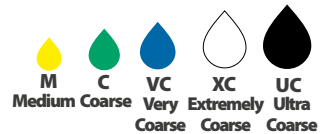
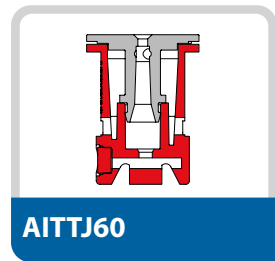
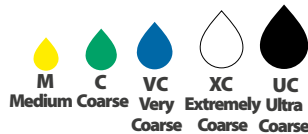
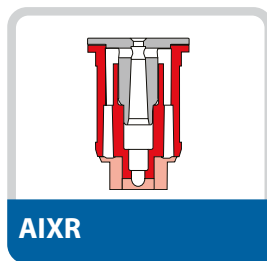


F M C VC XC UC
Fine Medium Coarse Very Coarse Extremely Coarse Ultra Coarse

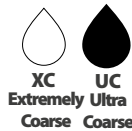
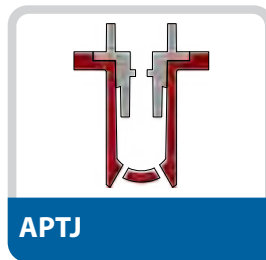


M C VC
Medium Coarse Very Coarse

- **Air induction spray tips** have two orifices. The first orifice, known as the pre-orifice, meters the liquid flow. The second orifice, known as the exit orifice, is larger than the pre-orifice and is responsible for forming the spray pattern. A Venturi system or air aspirator sits between the two orifices. This Venturi system draws air into the body of the tip where it is mixed with water. This mixing creates an air-entrained spray pattern at a lower pressure. The spray pattern is comprised of large, air-filled, coarse droplets with very few drift-susceptible droplets. The examples of TeeJet® Technologies' air induction tips are AI, AIXR, AITTJ60, TTI60, and TTI.



- **Recirculating chamber** – TeeJet® developed the first spray tip featuring a patent-pending recirculating chamber design with a concave exit orifice geometry. This design creates a pressure drop through the tip, resulting in optimal spray performance without the need for air induction, while significantly reducing driftable fines compared to a standard flat fan tip. The example of TeeJet® Technologies' low drift spray tip with a recirculating chamber is the AccuPulse® TwinJet®.



2.6.2 Nominal flow rate / Capacity

The nominal flow rate of a spray tip is determined by the volume of liquid sprayed by this tip or nozzle per unit of time, when operated at 40 PSI with water at 70°F (2.8 bar at 21°C). The flow rate indicated on a spray tip is expressed in U.S. gallons per minute (GPM). The nominal flow rate is directly related to droplet size. Spray tips with higher nominal flow rate generally produce coarser droplet sizes due to the larger exit orifice, which will result in the production of a thicker liquid sheet, larger ligaments, and subsequently coarser droplets. Conversely, spray tips with lower flow rate typically produce smaller droplets. In the table below, you can observe droplet size data for two different spray tips: a standard flat fan tip (XR) and its air-induction version (AIXR). In both columns, it is evident that spray tips with higher capacities produce coarser droplets.

XR110	30 PSI
XR11001	F
XR110015	F
XR11002	F
XR110025	M
XR11003	M
XR11004	M
XR11005	M
XR11006	M
XR11008	M
XR11010	C
XR11015	C
XR11020	VC

AIXR	60 PSI
AIXR110015	M
AIXR11002	M
AIXR110025	M
AIXR11003	M
AIXR11004	C
AIXR11005	C
AIXR11006	C
AIXR11008	VC
AIXR11010	VC

2.6.3 Pressure

When a liquid solution is sprayed at a certain pressure, the liquid is forced through the spray tip orifice, and a range of droplets is formed. The relationship between pressure and droplet size in spray applications is generally inverse. When you increase the pressure within the spray system, it usually leads to smaller droplet sizes. Higher pressure provides more energy to break the liquid into smaller particles, resulting in finer atomization. Conversely, reducing the pressure tends to produce larger droplets. Lower pressure means less energy for atomization, allowing larger droplets to form. Some spray tip types are more influenced by these properties than others.

	Pressure (PSI)	Droplet size
TT11002	15	VC
	30	C
	45	M
	60	M
	75	M
	90	F

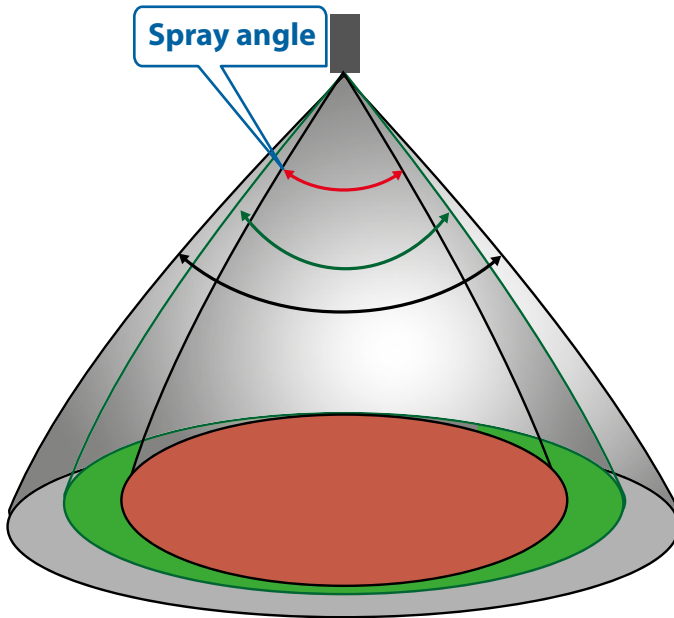
For example, the TT11002 tip produces coarse to very coarse droplets at pressures less than 30 PSI (2 bar), medium droplet size between 45 and 75 PSI (3 to 5 bar), and fine droplets when operated at pressures above 75 PSI (5 bar).

2.6.4 Tank mixture properties

Tank mixtures typically include a combination of pesticides and adjuvants, and this blend can impact the viscosity, viscoelasticity, and surface tension of the mixture. The viscosity, viscoelasticity, and surface tension of a tank mixture play a significant role in influencing the energy required for spray atomization. When either of these properties increases, it generally leads to a higher energy demand, subsequently resulting in larger droplet sizes during the spraying process. Certain types of spray tips are more impacted by these properties than others. Surface tension is often modified by addition of surfactant.

2.6.5 Spray angle

The spray angle is the measured outer included angle of a spray pattern near the spray tip orifice when spraying water. For a given flow rate, wider spray angles typically result in smaller droplet sizes. This is because a wider spray angle allows the liquid to disperse over a larger area, providing more space for atomization. Conversely, narrower spray angles concentrate the liquid into a smaller area, which can lead to larger droplets. However, the actual relationship can be influenced by various factors, including spray tip design, pressure, and the properties of the liquid being sprayed.



TP	PSI						
	20	25	30	35	40	50	60
TP4003	VC	C	C	C	C	M	M
TP6503	C	M	M	M	M	M	F
TP8003	M	M	M	M	M	F	F

The trajectory that droplets follow toward the target is influenced by a variety of factors. These include the type and angle of the spray tip, droplet size, velocity, pressure, tank mixture, prevailing weather conditions, the speed at which the sprayer travels, and other variables. Each of these factors plays a role in determining how droplets move and reach their intended destination during a spray application. Adjusting and optimizing these parameters allows for better control over droplet trajectory, aiding in effective coverage and minimizing potential issues like drift.



3.1 Factors affecting the droplet trajectory

3.1.1 Spray Tip Type

Different spray tip types have a distinct design that will impact on the droplet size, as we mentioned before, but also on the direction that the droplet is produced, affecting its trajectory. For example, the design of the flat fan tip AIXR results in droplets being produced vertically to the ground, while the flat fan tip TTI, due to its deflector design, the droplets are produced with a 15° attack angle. The spray orientation of the tip also plays a role in directing the droplets toward the target surface, impacting on the droplet's velocity.

3.1.2 Droplet Size

The size of the droplets influences their movement through the air and their susceptibility to environmental conditions, such as wind, temperature, and humidity. Smaller droplets are more prone to drift and follow different trajectories than larger ones.

3.1.3 Droplet Velocity

Refers to the speed at which individual droplets travel through the air from the spray tip to the target surface during the spraying process. It's a crucial factor that affects the behavior, trajectory, and effectiveness of the sprayed material. Droplet velocity is influenced by several factors, including the pressure at which the spray solution is released, droplet size, and air drag. Air drag is dependent on the droplet's diameter; smaller droplets lose velocity more quickly due to air resistance. As a result, smaller droplets are more likely to be blown off-target by wind compared to larger ones. In extreme cases, fine droplets may reach their terminal velocity before impact and drift freely. Additionally, even without wind, air drag can affect the point of impact based on droplet size. While this may not significantly impact broadcast spraying, it can be critical in specialized applications like targeted (spot) spraying.

3.1.4 Pressure

The pressure at which the spray solution is released from the tip determines the velocity of the droplets. The effect of pressure in droplet velocity will be dependent on the droplet size and spray tip type.

3.1.5 Tank Mixture

The composition of the tank mixture can indirectly influence droplet trajectory during a spraying operation through various mechanisms. While the tank mixture itself doesn't directly dictate the physical movement of droplets, certain properties of the mixture, such as viscosity and surface tension, can affect droplet behavior and, consequently, their trajectory

3.1.6 Weather Conditions

Play a significant role in determining the trajectory and behavior of sprayed droplets.

- **Wind speed and direction** are the primary factors affecting droplet movement during application. Higher wind speeds can drag droplets to drift away from the target area, leading to off-target deposition. The direction of the wind determines the path and extent of drift, influencing where the droplets will be carried. The effect of pressure in droplet velocity will be dependent on the droplet size and spray tip type.

- **Temperature and humidity** can affect the droplets' lifetime. Higher temperatures and low humidity can lead to increased evaporation rates of droplets. In hot and dry conditions, smaller droplets are more prone to evaporate before reaching the target, affecting coverage and efficacy. In addition, even after reaching the plant, for example, smaller droplets are more susceptible to evaporate from the leaf's surface before the active ingredient of the pesticide is absorbed by the plant.

- **Atmospheric stability and temperature inversion:** Atmosphere can impact droplet dispersion and movement. Stable atmospheric conditions tend to limit vertical movement of droplets, while unstable conditions and temperature inversion can lead droplets to deposit away from the intended target.

3.1.7 Sprayer Travel Speed

Sprayers using a rate controller to maintain the application rate when travel speed is increased automatically increase pressure, which will directly impact the droplet size. Also, smaller droplets are more affected by the air turbulence resulting from the sprayer travel, which can result in carrying those droplets away from the targeted area.

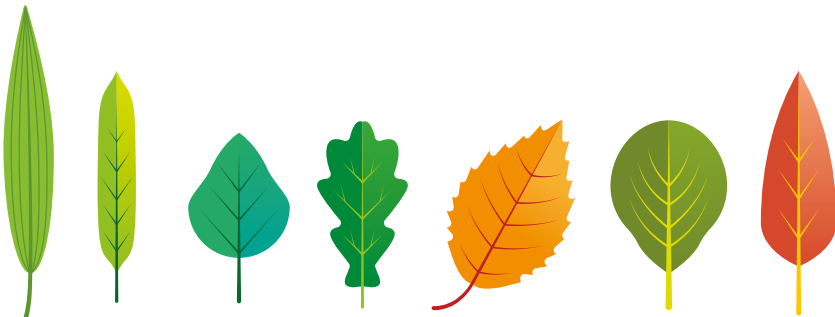
3.2 Factors affecting spray retention

When a droplet makes contact with a leaf surface, it begins to spread out, forming a thin liquid film known as a lamella. This initial impact is influenced by both the properties of the liquid and the surface.

Interaction between pesticide droplets and leaf surfaces is a complex process influenced by a variety of factors, including **3.2.1** leaf characteristics, **3.2.2** pesticide properties, **3.2.3** formulation, **3.2.4** environmental conditions, **3.2.5** application techniques, **3.2.6** application volume, and **3.2.7** droplet velocity and droplet size.

3.2.1 Leaf characteristics

Different types of leaf surfaces, such as hairy, smooth, rough, or waxy, can affect the behavior of pesticide droplets. Hairy leaves may trap droplets, preventing them from spreading uniformly, while waxy leaves may repel droplets, making adhesion and coverage more challenging. Leaf shape and orientation also contribute to spray retention.



Examples of leaf shapes and textures

3.2.2 Pesticide properties

The physical and chemical properties of the pesticide formulation and the tank mixture can impact how droplets spread and adhere to leaf surfaces. Spray additives, or adjuvants, are substances incorporated into tank mixes to enhance or modify the activity of the pesticide and/or the physical properties of the tank mixture.

- **Activator adjuvants**, which include surfactants (e.g., nonionic surfactants, organo-silicone surfactant, anionic surfactant, and cationic surfactant), oils (e.g., crop oil concentrate, high-surfactant oil concentrate, methylated seed oils), and nitrogen-based fertilizers (e.g., ammonium sulfate and urea ammonium nitrate) alter the properties of the tank mixture aiming to increase absorption and reduce surface tension on the leaf.

- **Modifier additives**, such as anti-foaming agents, compatibility agents, and drift control agents, are designed to alter the application characteristics of the spray solution and mitigate specific conditions that can negatively impact the application of the tank mixture.

3.2.3 Pesticide formulation

The formulation of the pesticide can affect droplet behavior. For example, emulsifiable concentrates (ECs) and oil-based formulations may spread differently on leaves compared to water-based solutions.

3.2.4 Environmental conditions

Rain, humidity, and temperature can affect the behavior of droplets on leaf surfaces. Rain can wash away applied pesticides, while temperature and humidity affect pesticide evaporation.



Soybean leaves covered with rain drops

3.2.5 Application techniques

Proper spray equipment and techniques, including spray tip selection, play a crucial role in ensuring that droplets are delivered and spread effectively on leaf surfaces. Different spray techniques (e.g., air-assisted, electrostatic, etc.) as well as spray tip types can yield different droplet size distributions and velocities, which in turn affect droplet behavior.

3.2.6 Application volume

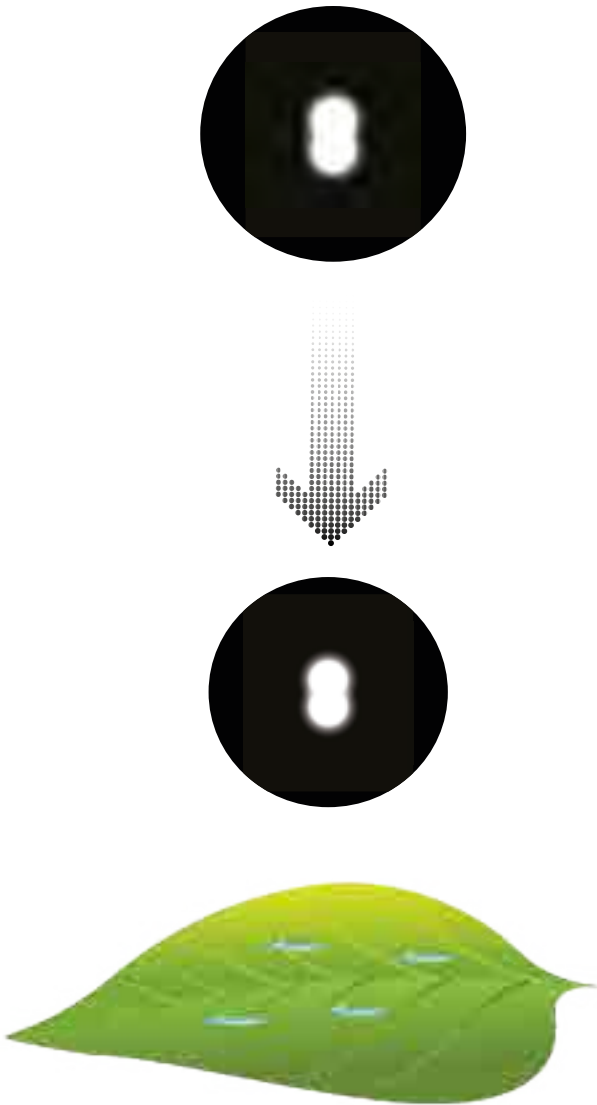
Higher application volume increases the amount of spray solution reaching the leaves, leading to better coverage and potentially more uniform deposition of the pesticide. This can enhance retention as more of the active ingredient is distributed across the leaf surface. However, excessive application volume can lead to run off, where excess liquid drips off the leaves, reducing retention. Run off is particularly problematic if the leaves are already covered by rain or dew or if the spray is applied too heavily. Adequate volume ensures good coverage without causing excessive run off, thus optimizing retention.

3.2.7 Droplet velocity and droplet size

Droplet velocity, or the speed at which the droplets are ejected from the tip, can influence spray retention. High spray velocities can help droplets reach targets that are further away or positioned down in the canopy. However, it can also lead to droplet bounce or shatter and potentially reduce spray retention.

Droplet size in a spray is crucial. Smaller droplets may have higher surface area-to-volume ratios, potentially improving their ability to stick to surfaces. However, finer droplets may be more prone to drift or evaporate before reaching the target.

Air inclusion in droplets significantly impacts their behavior and retention characteristics. Droplets filled with air, known as air-included droplets, experience an increase in size and become lighter. This alteration in their physical properties affects their dynamics upon impact. When air-included droplets impact a surface, the increased size and reduced density promote breakup upon contact. However, depending on the pesticide formulation, air induction tips and conventional spray tips that produce similar droplet size rarely show significant differences.



Example of an air-included droplet reaching the target and breaking up upon contact

Understanding these factors and optimizing pesticide application methods are essential for achieving uniform coverage and ensuring that the pesticide will be effectively retained on the target.

3.3 Impaction process

After impact on the leaf surface, a droplet can exhibit various behaviors, including 3.3.1 retention on the leaf, 3.3.2 shattering, 3.3.3 run off, or 3.3.4 bouncing off the edge. Ideally, the droplet adheres to the leaf surface, ensuring that the pesticide remains in place. This allows for the active ingredients in the pesticide to be absorbed and translocated to the target site.

3.3.1 Retention

Proper adhesion is often the desired outcome to ensure the effective delivery of the sprayed pesticide. Achieving good retention depends on factors like droplet size, adhesion properties of the target surface, and the use of adjuvants or surfactants to improve wetting and adhesion. If the droplet's energy is sufficiently dissipated during the spreading and receding phases, it will adhere to the leaf surface. In addition, air-included droplets when they reach the target can break, spread, and be retained effectively on the leaf.

3.3.2 Shattering

The droplet breaks into smaller droplets upon impact. This typically occurs at higher impact velocities or when the surface is superhydrophobic. The kinetic energy of the droplet overcomes the cohesive forces, causing fragmentation. In some cases, even after shattering, droplets may still adhere to the target surface or fall to the ground. Shattering is undesirable in many applications as it can reduce coverage and effectiveness.

3.3.3 Run Off

On certain surfaces, especially those with low adhesion properties, droplets might run off rather than adhere. This behavior is common when droplets encounter surfaces with low adhesion properties, such as waxed leaves, or when the leaves are already covered by rain or dew. It can also occur if the spray is applied too heavily, leading to excessive runoff rather than adequate adhesion.

3.3.4 Bouncing Off

The droplet rebounds from the surface. This behavior is common on non-wettable surfaces (e.g., superhydrophobic surfaces) where the droplet maintains a high degree of spherical shape and minimal contact with the surface. It is also observed with high-velocity droplets and depends on the nature of the liquid applied.



Retention



Shattering



Air-induced droplets retained



Run Off



Bouncing Off

4

Optimum Droplet Size Range

4.1 Optimum droplet size range

Determining the optimum droplet size range for pesticide application involves balancing several factors to achieve efficient coverage while minimizing drift and maximizing efficacy. The ideal droplet size range can vary based on the specific pesticide, target pest, application method, pesticide label recommendations, and environmental conditions. However, generally speaking, we should consider the following:

1) Driftable fines (< 150 μm)- Very Fine (VF) to Fine (F) droplet size classification

These smaller droplets are indeed more prone to drift. They can be carried by wind or air currents, potentially causing off-target effects and reduced efficacy in reaching the intended area.

2) Optimum droplet size range (150 - 600 μm) - Fine (F) to Extremely Coarse (XC) droplet size classification

Droplets within this range typically offer a good balance between coverage and reduced drift. They provide adequate coverage on the target while being less susceptible to particle movement due to weather conditions.

3) Shatterable droplets (> 600 μm) - Extremely Coarse (XC) to Ultra Coarse (UC) droplet size classification

Droplets in this range are unlikely to drift away but can exhibit other behaviors upon impact with the target. They can shatter, bounce, or run off, potentially reducing the effectiveness of the application. The inclusion of additives that help retention is crucial if working with this droplet size range. Some formulations are more likely to shatter on hairy leaf surfaces, while others tend to bounce on smooth leaf surfaces, especially when the droplet size becomes too large, too fast, or both.

On the other hand, droplets filled with air within this droplet size range upon hitting the target can break up and be retained at the leaf. This happens because air-included droplets have lower velocity allowing them to distribute the liquid more effectively across surfaces and adhere to the target. This slower droplet velocity enhances the effectiveness of the application by maximizing the contact area and coverage.

It is important to note that the ideal droplet size range might vary based on the specific requirements of the pesticide and the target. Factors such as the pesticide label, plant's structure, the nature of the pest, and environmental conditions (wind speed, temperature, humidity) all play a role in determining the optimal droplet size for effective pesticide application.

Applicators often utilize different spray tip types, pressures, and spray formulations to achieve the desired droplet spectrum tailored to the specific conditions and target pests. Finding the right balance between coverage and drift reduction is crucial to maximize the efficacy of pesticide application while minimizing environmental impact.

Always follow the pesticide label recommendations for better product effectiveness.

4.2 Spray tips for varied droplet sizes

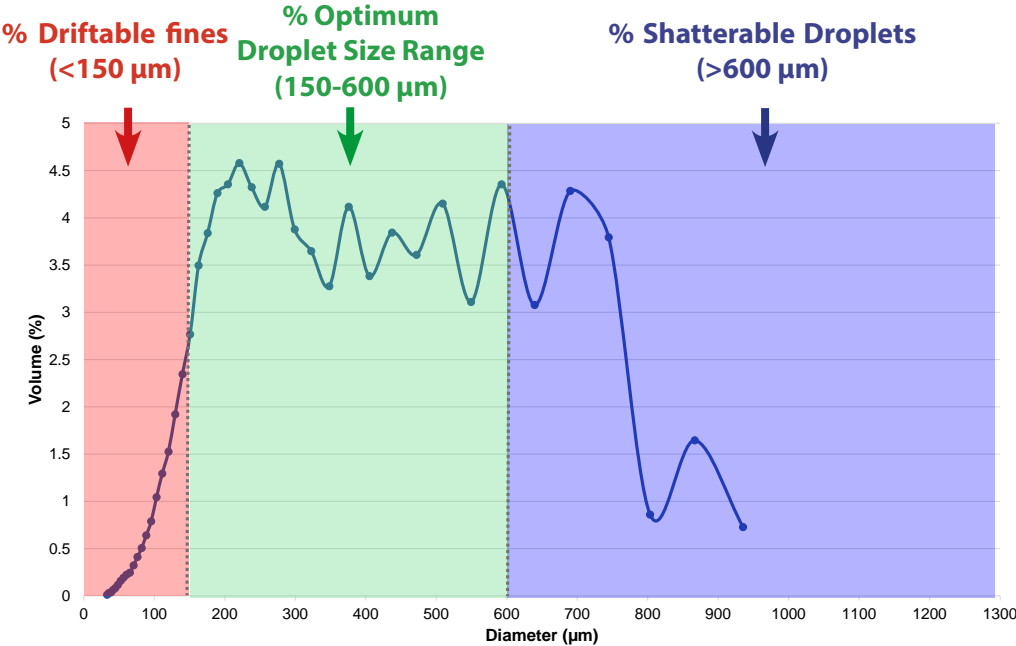
As technology advances, the need for the development of highly specific spray tips becomes increasingly important. Precise characteristics such as droplet size, spray angle, pattern, attack angle, and reduced driftable fines droplets are important to meet diverse spraying needs. An illustrative example of this evolution is the response to the growing concern over environmental contamination, which led to the creation of spray tips designed to reduce driftable fines while still maintaining exceptional performance during application.

Stepping back in time to where the journey of more precise spray tips began, in 1985 TeeJet® introduced the Extended Range (XR) tips with the objective of delivering optimal droplet size across an extended pressure range. XR had the innovative incorporation of a color-code design, VisiFlo® which is a color-coding classification system, in which each color represents the nominal flow of a spray tip at 40 PSI (2.8 bar). The system quickly became a standard classification system in the agricultural spray tip industry, as well as by the international ISO 10625 standard in 2018. This color coding system simplified spray tip selection for users. The XR spray tip is still used for a wide range of applications, but it was developed when spray drift was not an important concern and the percentage of driftable fines produced by this tip is still high. As concerns about off-target movement and environmental contamination rose, TeeJet® maintained a strong commitment to produce high-quality products to meet market needs. In 1995 the Turbo TeeJet® spray tip was introduced to the market. This innovative tip produces a similar droplet size as the XR family but with significantly fewer driftable fines. The patented unique design of Turbo TeeJet enhances coverage and penetration, contributing to improved application efficacy and mitigation of spray drift.

Since then, TeeJet has been developing a wide range of products to address every market need, from droplet size, percentage of driftable fines, to spray tips compatible with PWM systems, drones, and targeted spray technologies.

Now, let's dive into the characteristics, benefits, and applications of TeeJet® Technologies' most popular spray tips. Through this exploration, we'll gain insights into adopting more sustainable practices during pesticide applications by selecting the appropriate spray tips.

Under each spray tip you will find a graphic to represent the droplet size distribution of the given example and color boxes that represent the percentage of the volume of the given tip that is in each category - Driftable fines, Optimum droplet size range, and Shatterable droplets, as on the example below.



4.2.1 XR TEEJET®



The XR – Extended Range spray tip was one of the first spray tip types that could produce the same spray angle across a wide range of spraying pressures for use with automatic rate controllers by TeeJet. It is a multipurpose spray tip for when coverage is critical. Inserts are available in polymer, ceramic and stainless steel.

Features & Benefits

SPRAY PATTERN



Tapered - available in 80° or 110°

EXCELLENT DISTRIBUTION



of spraying in a pressure range of 15-60 PSI (1-4 bar)

HIGHER DRIFT CONTROL



when used with pressures between 15-30 PSI (1-2 bar)

GREATER COVERAGE



when used with pressures higher than 30 PSI (2 bar)

CONSISTENT DROPLET SIZE RANGE



Droplets of equal size guarantees a more effective application

DROPLET SIZE VERSATILITY



Fine to Extremely Coarse droplets

XR TEEJET® (XR)

TIP PART NO.	PSI					
	15	20	30	40	50	60
XR8001	F	F	F	F	F	F
XR11001	F	F	F	F	F	VF
XR80015	M	F	F	F	F	F
XR110015	M	F	F	F	F	F
XR8002	M	M	F	F	F	F
XR11002	M	M	F	F	F	F
XR80025	M	M	M	F	F	F
XR110025	M	M	M	F	F	F
XR8003	M	M	M	F	F	F
XR11003	M	M	M	F	F	F
XR80035	M	M	M	M	F	F
XR8004	M	M	M	M	F	F
XR11004	M	M	M	M	F	F
XR8005	C	M	M	M	F	F
XR11005	M	M	M	M	M	F
XR8006	C	C	M	M	M	M
XR11006	C	M	M	M	M	M
XR8008	VC	C	C	M	M	M
XR11008	C	M	M	M	M	M
XR8010	VC	C	C	M	M	M
XR11010	C	C	C	M	M	M
XR8015	XC	VC	VC	C	C	M
XR11015	VC	VC	C	C	C	M
XR11020	XC	VC	VC	C	C	C

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).

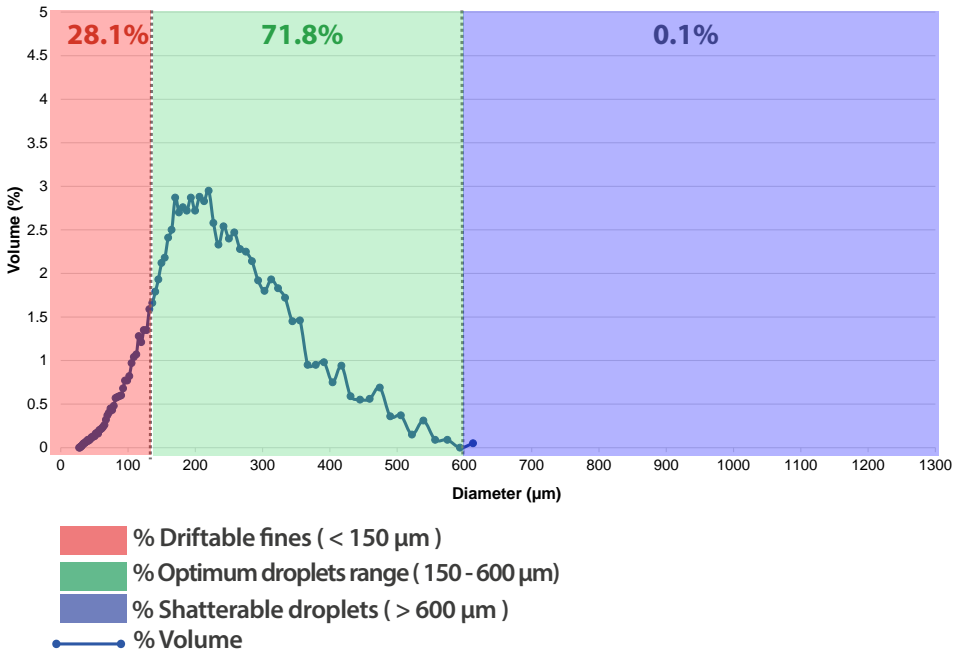


Due to the lack of drift mitigation technology, the XR tip produces a higher volume of driftable fines compared to newer tips, such as the Turbo TeeJet® tip. As shown in the image above, an XR11004 at 40 PSI (2.8 bar) tested with water produced around 28% of driftable fines. When a 5 MPH (8 km/h) wind is added, these finer droplets are easily dispersed by the wind current.

Optimum Droplet Size

As shown in the image below, about 71.8% of the droplets produced by the XR11004 at 40 PSI fall within the optimum droplet size range, 28% of the droplets are classified as driftable fines, and only 0.1% are categorized as shatterable droplets. Despite the high percentage of droplets in the optimum size range, the XR tip still produces a significant amount of driftable fines, which could be an issue due to the potential loss during application. Therefore, the XR tip is ideal for use when spray drift is not a big concern or when an additional drift mitigation technique is adopted.

Percentage of droplets distributed by diameter frequencies of XR11004 at 40 PSI.



4.2.2 TURBO TEEJET® - TT



Turbo TeeJet (TT) was the first tip developed with a droplet size up to 60% bigger than standard extended range tip - XR, resulting in a lower volume of driftable droplets. The combination of attack angle, wide spray angle, and excellent uniformity in the droplet size promotes better coverage on different targets.

Features & Benefits

WIDER SPRAY ANGLE



Boom operates at a lower height reducing the chance of drift, providing better coverage

15° ATTACK ANGLE



Provides better crop canopy penetration.
Make sure the spray is not colliding with the sprayer parts

WIDE OPERATING PRESSURE RANGE



15-90 PSI (1-6 bar)

DROPLET VERSATILITY



Fine to Extremely Coarse droplets

CONSISTENT DROPLET SIZE RANGE



Droplets of equal size guarantees a more effective application

SUPERIOR SPRAY DISTRIBUTION QUALITY



Even coverage across the boom width

TURBO TEEJET® (TT)

TIP PART NO.	PSI										
	15	20	25	30	35	40	50	60	70	80	90
TT11001	VC	C	C	M	M	M	M	M	F	F	F
TT110015	VC	VC	C	C	C	M	M	M	M	F	F
TT11002	VC	VC	C	C	C	M	M	M	M	F	F
TT110025	VC	VC	C	C	C	M	M	M	M	F	F
TT11003	XC	VC	VC	C	C	M	M	M	M	F	F
TT11004	XC	VC	VC	C	C	M	M	M	M	F	F
TT11005	XC	VC	VC	C	C	M	M	M	M	F	F
TT11006	XC	VC	VC	C	C	M	M	M	M	F	F
TT11008	XC	VC	VC	VC	C	M	M	M	M	M	F
TT11010	UC	XC	XC	VC	VC	VC	C	C	C	M	M
TT11012	UC	XC	XC	XC	VC	VC	VC	VC	C	C	C

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).

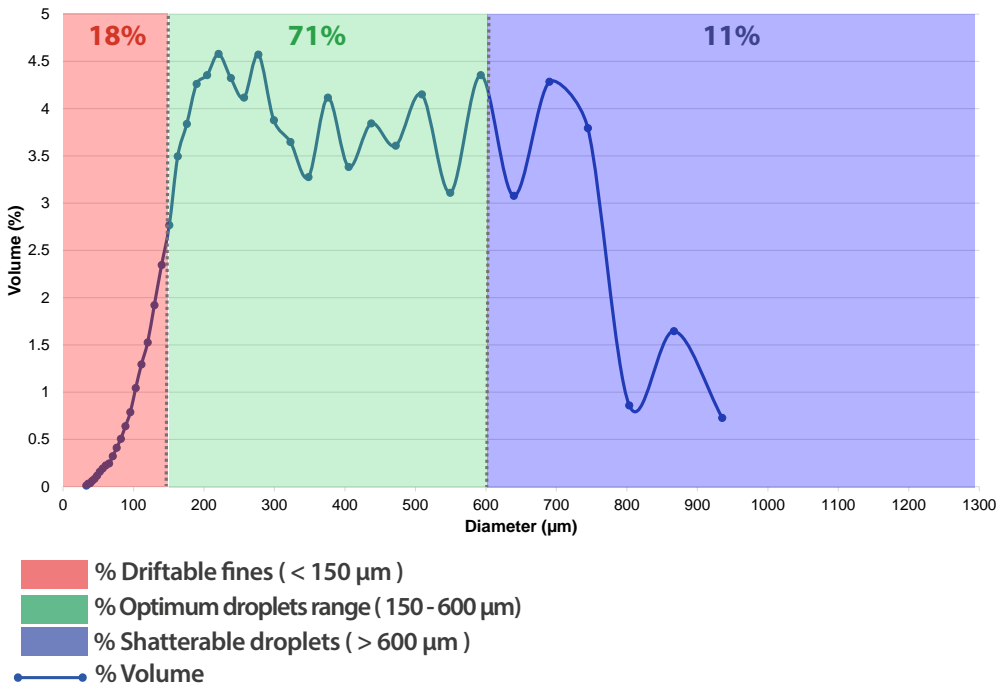


Even though the droplet size range produced by TT tips is similar to those produced by XR tips, the Turbo technology in TT tips significantly reduces the percentage of driftable fines. For example, a TT11004 at 40 PSI (2.8 bar) tested with water produced only around 18% driftable fines (Image above) versus the 28% produced by XR. When a 5 MPH (8 km/h) wind is added, the difference in the dispersion of finer droplets compared to the XR tip is even more notiable.

Optimum Droplet Size

As shown in the image below, 71% of the droplets generated by the TT11004 at 40 PSI fall within the optimal droplet size range. Comparatively, 18% of these droplets are categorized as driftable fines, and 11% fall under the classification of shatterable droplets. Overall, when considering TT tips with the same capacity and operating at the same pressure as XR tips, the droplet sizes and the optimal droplet size range remain similar. However, the enhanced design of TT tips results in a notable 10% reduction in driftable fines. Consequently, for safer application, selecting a tip that produces the right droplet size with minimal drift is highly desirable.

Percentage of droplets distributed by diameter frequencies of TT11004 at 40 PSI (2.8 bar).



4.2.3 TURBO TWINJET® - TTJ60



The TTJ60 spray tip features a design with an exclusive symmetrical twin spray pattern, capable of producing droplets with greater resistance to drift, resulting in a safer application. The combination of uniform droplet size, lower driftable fines, optimal attack angle, and droplets sprayed at different angles by the twin spray pattern results in exceptional coverage across various types of targets.

Features & Benefits

SPRAY PATTERN



Twin Flat Fan

TWIN FLAT FAN ATTACK ANGLE



60° angle between sprays provides ideal inclination to a superior penetration and targeted coverage

SUPERIOR COVERAGE



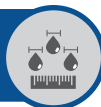
Due to the combination of uniform droplet size, reduced driftable fines, attack angle and droplets projected in different directions

SUPERIOR SPRAY DISTRIBUTION QUALITY



Even coverage across the boom width

CONSISTENT DROPLET SIZE RANGE



Droplets of equal size guarantees a more effective application

DROPLET SIZE VERSATILITY



Medium to Very Coarse droplets

TURBO TWINJET® (TTJ60)

TIP PART NO.	PSI									
	20	30	40	50	60	70	80	90	80	90
TTJ60-11002	C	C	M	M	M	M	M	M	M	M
TTJ60-110025	VC	C	M	M	M	M	M	M	M	M
TTJ60-11003	VC	C	C	M	M	M	M	M	M	M
TTJ60-11004	VC	C	C	M	M	M	M	M	M	M
TTJ60-11005	VC	C	C	M	M	M	M	M	M	M
TTJ60-11006	VC	C	C	M	M	M	M	M	M	M
TTJ60-11008	VC	C	C	M	M	M	M	M	M	M
TTJ60-110010	VC	C	C	C	M	M	M	M	M	M

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).

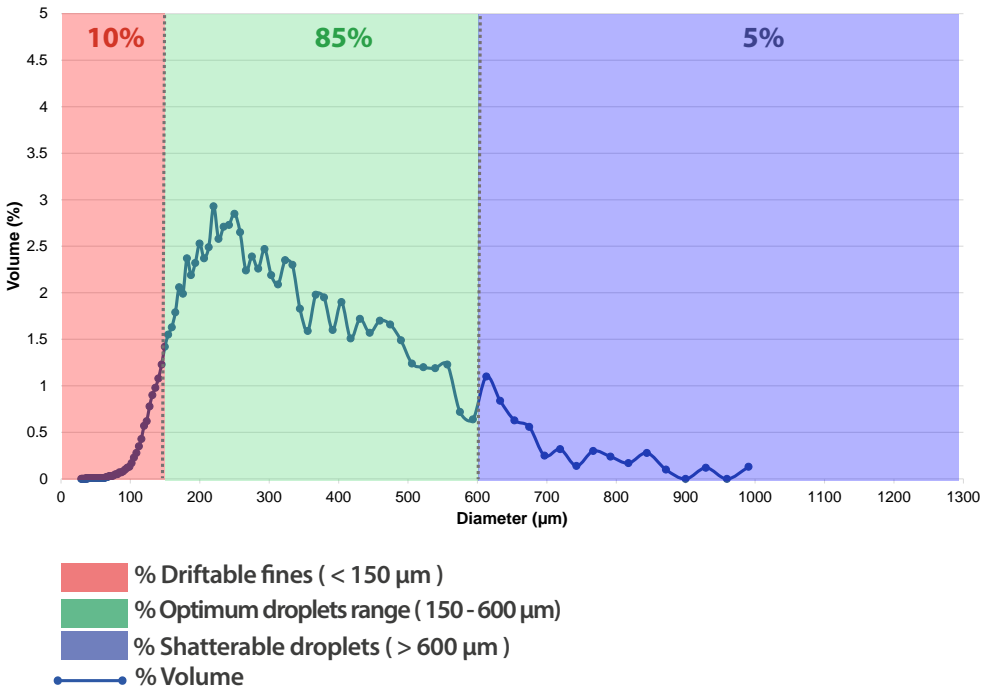


Due to the Turbo technology embedded in the TTJ60, this tip produces a lower volume of driftable fines compared with other similar dual fan tips available on the market. For example, a TTJ60-11004 at 40 PSI (2.8 bar) tested with water produced around 10% driftable fines (image above). When a 5 MPH (8 km/h) wind is added to the comparison, there is a noticeable reduction in the dispersion of finer droplets compared to the examples presented above.

Optimum Droplet Size

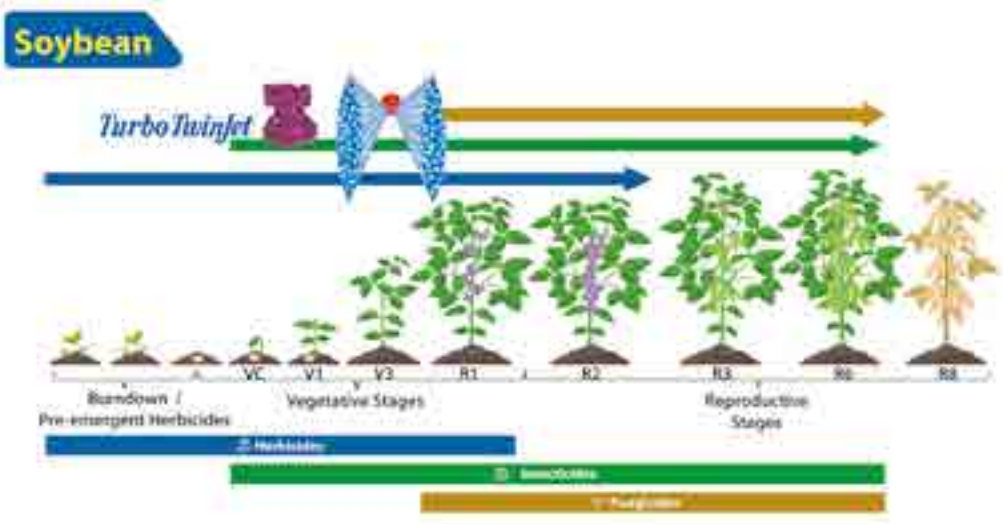
In the provided image below, it's evident that 85% of the droplets generated by TTJ60-11004 at 40 PSI fall within the optimal droplet size range. Remarkably, only 10% of these droplets are categorized as driftable fines, with a mere 5% falling under the classification of shatterable droplets. Typically a TwinJet® spray pattern tip would produce smaller droplets and increased driftable fines; however, TTJ60 features the Turbo design that enables this tip to produce coarser droplets that fall within the optimal size range while significantly reducing both driftable fines and shatterable droplets when compared to previous tips like XR and TT.

Percentage of droplets distributed by diameter frequencies of TTJ60-11004 at 40 PSI (2.8 bar)

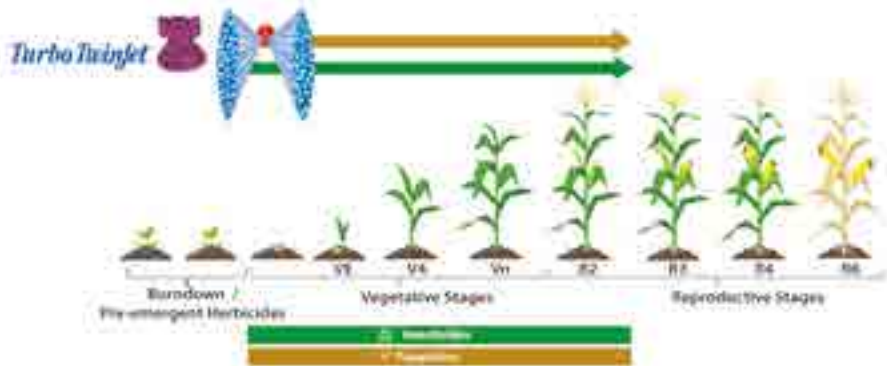


Applications of TTJ60

As an example, the TTJ60 tips can be used for herbicides, insecticides, and fungicides application in soybean and cotton, and for insecticides in corn and wheat crops when an improved penetration and coverage in dense canopies is needed. The 60° angle between the spray patterns provided by the TTJ60 spray tip was designed to facilitate better canopy penetration of fungicides to reach the lower parts of the plant and underleaf where diseases typically start to develop. In addition, the increased number of droplets produced by the TTJ60 tip compared to a single-pattern tip design promotes better coverage and penetration. This is particularly beneficial when applying contact herbicides such as glufosinate or a fungicide during a reproductive stage where the canopy is a challenging barrier.



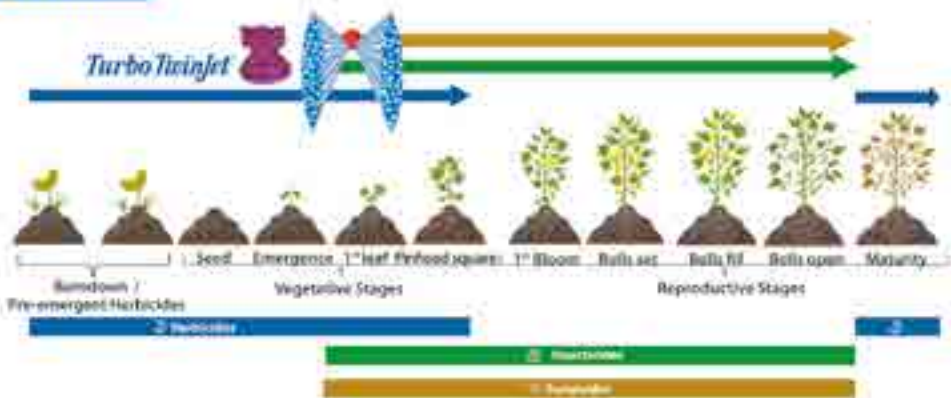
Corn



Wheat



Cotton



4.2.4 AIR INDUCTION XR TEEJET® - AIXR



The AIXR spray tip features a latest generation air induction system, responsible for producing larger air-filled droplets resulting in less drift. The combination of uniform droplet size, lowest percentage of driftable droplets and greater droplet velocity towards the target result in a perfect balance between drift control, coverage and penetration, for a safer application of pesticides.

Features & Benefits

SPRAY PATTERN



Tapered - available in 80° or 110°

COMPACT SIZE



to prevent tip damage

AIR INDUCTION SYSTEM



produces larger air-filled droplets, resulting in less drift

DROPLET SIZE VERSATILITY



Medium to Extremely Coarse droplets

GREATER DROPLET VELOCITY



Product reaches the target faster and improves efficiency of spray

SUPERIOR SPRAY DISTRIBUTION QUALITY



Even coverage across the boom width

AIXR TEEJET® (AIXR)

TIP PART NO.	PSI										
	15	20	25	30	35	40	50	60	70	80	90
AIXR110015	VC	VC	C	C	C	C	M	M	M	M	M
AIXR11002	XC	VC	VC	VC	C	C	M	M	M	M	M
AIXR110025	XC	VC	VC	VC	C	C	M	M	M	M	M
AIX11003	XC	VC	VC	VC	C	C	C	M	M	M	M
AIXR11004	XC	VC	VC	VC	VC	C	C	C	M	M	M
AIXR11005	XC	XC	VC	VC	VC	VC	C	C	C	M	M
AIXR11006	XC	XC	XC	VC	VC	VC	VC	C	C	C	C
AIXR11008	UC	XC	XC	XC	VC	VC	VC	VC	C	C	C
AIXR11010	UC	UC	XC	XC	XC	VC	VC	VC	VC	C	C

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).

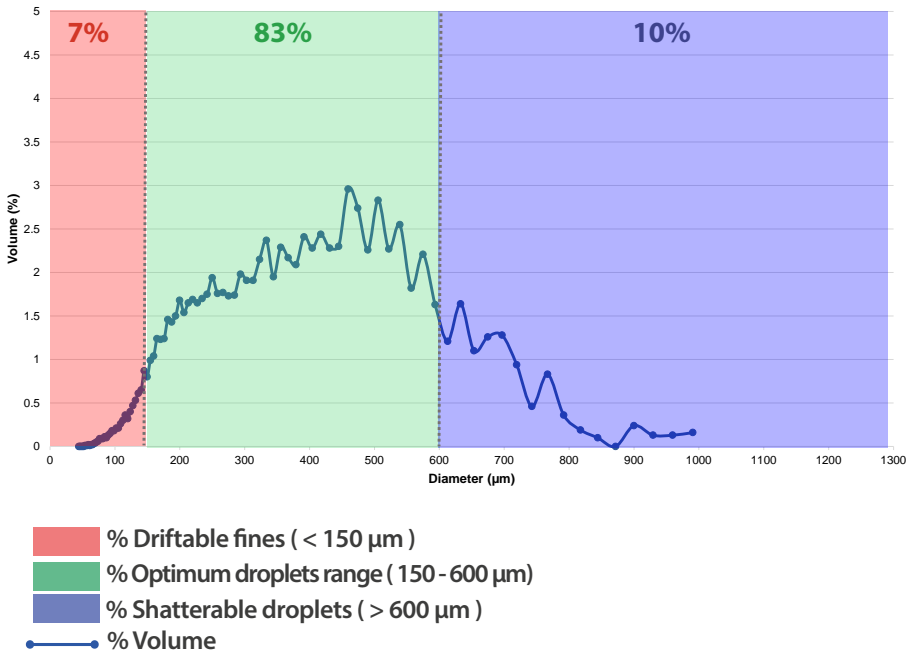


The AIXR tip produces large air-filled droplets and fewer driftable fines due to the Venturi air aspirator. For example, an AIXR11004 at 40 PSI (2.8 bar) tested with water produced around 7% of driftable fines. When a 5 MPH (8 km/h) wind is added, there is a significant reduction in the dispersion of finer droplets compared to the examples presented above without air induction.

Optimum Droplet Size

In the given image below, it's noticeable that 83% of the droplets produced by the AIXR11004 at 40 PSI fall within the optimal droplet size range. A mere 7% of these droplets are labeled as driftable fines, while 10% fall into the shatterable droplets category. The Venturi air induction system significantly influences the reduction of driftable fines and enhances the proportion of droplets within the optimal size range and shatterable classification. This versatility makes the AIXR tip well-suited for a diverse range of pesticide applications.

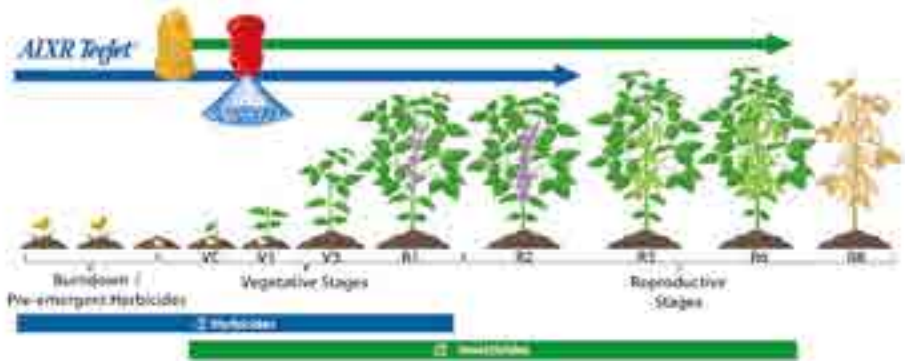
Percentage of droplets distributed by diameter frequencies of AIXR11004 at 40 PSI (2.8 bar)



Applications of AIXR TEEJET®

The unique droplet size range combined with the droplet velocity makes AIXR ideal for herbicide applications, as the systemic 2,4-D herbicide formulated with choline salt, and for insecticide applications. The droplet size range produced by AIXR tips is versatile enough to control spray drift while promoting great coverage of the target.

Soybean



Corn



Wheat



Cotton



4.2.5 AIR INDUCTION TURBO TWINJET® - AITTJ60



The AITTJ60 spray tip features an exclusive patented design, where its air induction system with Turbo design produces coarser droplets while still offering the improved coverage of a twin spray pattern. This combination of air induction and Turbo technology produces coarser droplets with more momentum to resist drift, while the dual attack angle promotes droplets sprayed at different angles, resulting in improved coverage.

Features & Benefits

SPRAY PATTERN



Twin Flat Fan

TWIN FLAT FAN ATTACK ANGLE



60° angle provides ideal inclination to a superior penetration and targeted coverage

SUPERIOR COVERAGE



Uniform droplet size, reduced driftable fines and droplets projected in different directions

AIR INDUCTION SYSTEM



produces larger air-filled droplets, resulting in less drift

DROPLET SIZE VERSATILITY



Medium to Ultra coarse droplets

SUPERIOR SPRAY DISTRIBUTION QUALITY



Even coverage across the boom width

AIR INDUCTION TURBO TWINJET® (AITTJ60)

TIP PART NO.	PSI							
	20	30	40	50	60	70	80	90
AITTJ60-11002	XC	VC	VC	C	C	C	C	M
AITTJ60-110025	XC	VC	VC	VC	C	C	C	C
AITTJ60-11003	XC	XC	VC	VC	C	C	C	C
AITTJ60-11004	XC	XC	VC	VC	C	C	C	C
AITTJ60-11005	UC	XC	VC	VC	VC	C	C	C
AITTJ60-11006	UC	XC	VC	VC	VC	C	C	C
AITTJ60-11008	UC	XC	XC	XC	VC	VC	VC	VC
AITTJ60-11010	UC	XC	XC	XC	VC	VC	VC	VC
AITTJ60-11015	UC	XC	XC	XC	VC	VC	VC	VC

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).



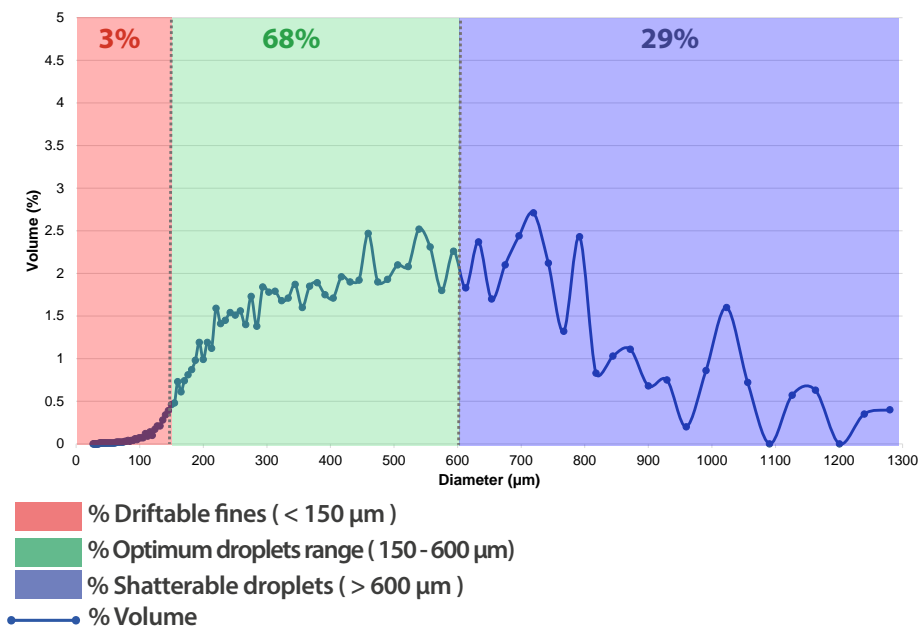
AITTJ60 tip produces large air-filled droplets and less driftable fines due to the Venturi air aspirator. For example, an AITTJ60-11004 at 40 PSI (2.8 bar) tested with water produced around 7.5% of driftable fines. When a 5 MPH (8 km/h) wind was added, it is possible to observe a significant reduction of the finer droplets dispersion when compared with non air induction tips, such as TTJ60 and XR tips.

Optimum Droplet Size

The graph below, shows how when the AITTJ60-11004 is operated at 40 PSI, 68% of the produced droplets fall within the optimum droplet size range. Notably, although 29% of these droplets are categorized as "shatterable," the AITTJ60 incorporates a Venturi air aspirator that fills the droplets with air. This innovative feature plays a crucial role: instead of shattering upon reaching the target, the air-filled droplets break into much smaller droplets that facilitate the retention of the pesticide solution at the intended location.

Furthermore, a mere 3% of the droplets are classified as "driftable fines," enhancing the effectiveness of the AITTJ60 in minimizing potential drift. This detailed analysis highlights the AITTJ60's ability to produce a significant proportion of droplets within the optimum size range, coupled with the unique Venturi air aspirator mechanism, which contributes to the precision and efficacy of pesticide application while mitigating unwanted spray drift.

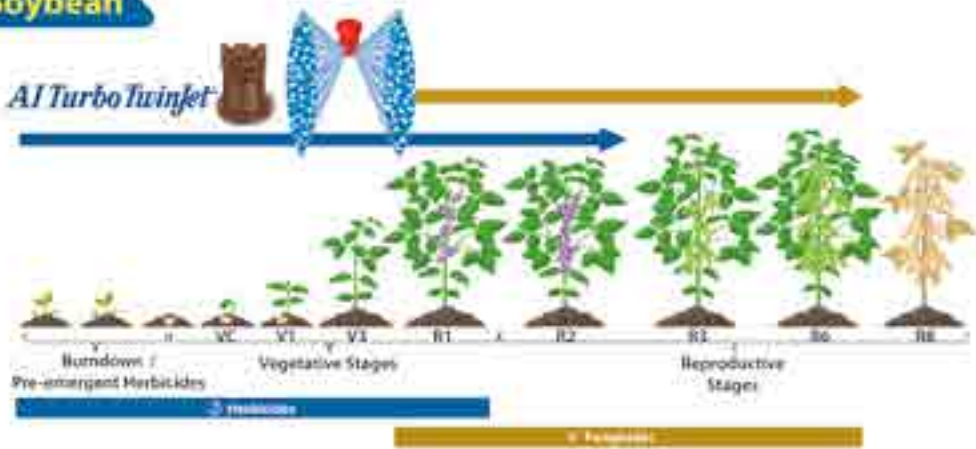
Percentage of droplets distributed by diameter frequencies of AITTJ60 -11004 at 40 PSI (2.8 bar)



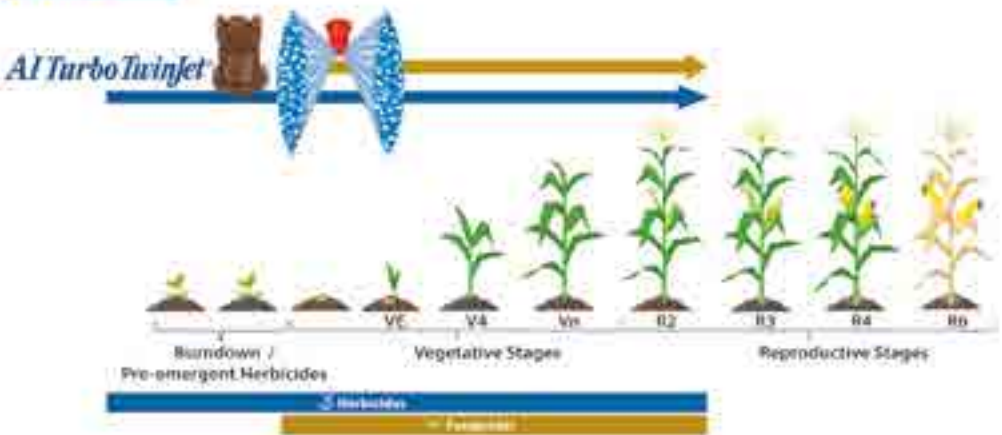
Applications of AITTJ60

The Air Induction TurboTwinJet® is ideal for herbicide applications from burndown to post-emergent applications in crops that require Coarse (C) to Very Coarse (VC) droplet size. The air induction technology in this tip produces coarser drift-resistant droplets. The combination of the dual symmetric flat fan pattern and the 60° angle between spray patterns, results in greater performance in coverage & penetration to the canopy due to the production of a greater number of droplets.

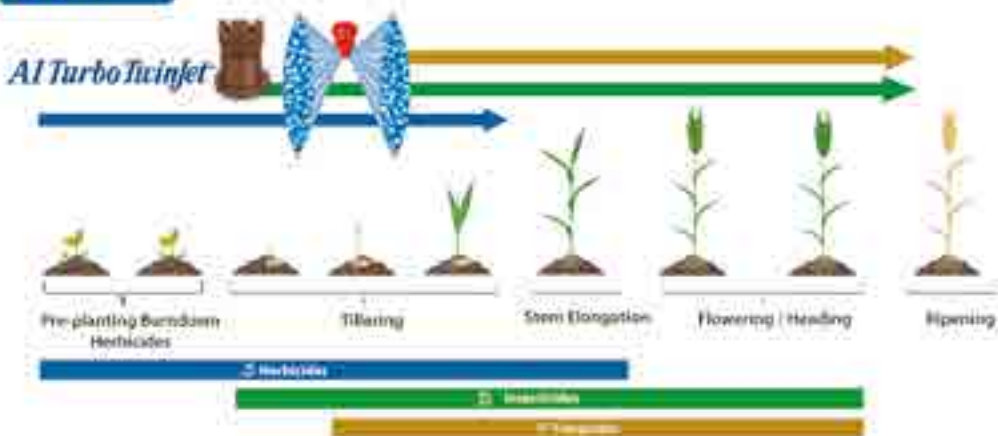
Soybean



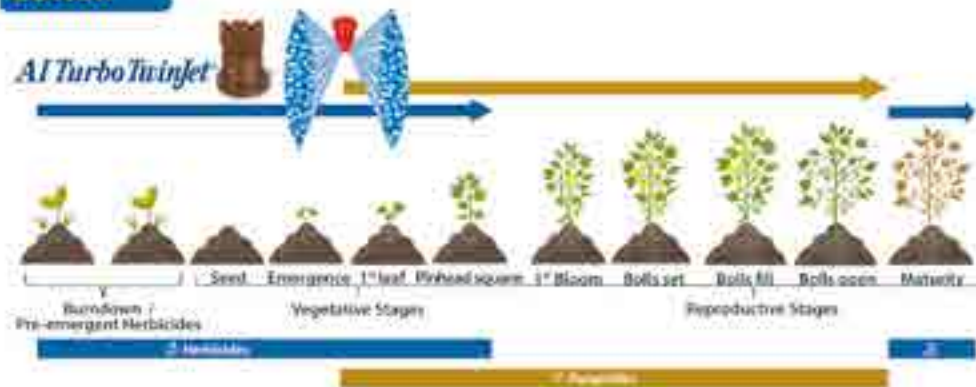
Corn



Wheat



Cotton



4.2.6 TURBO TEEJET® INDUCTION - TTI



Turbo TeeJet® Induction spray tip has an exclusive patented design, where its pre-orifice and Venturi system reduce fine droplets, producing ultra coarse air-filled droplets for Maximum Drift Control. The combination of consistent droplet size, lowest percentage of driftable droplets available, and attack angle of 15° results in maximum balance between drift control, coverage, and penetration, for safe and high-performance pesticide application.

Features & Benefits

SPRAY PATTERN



Tapered

AIR INDUCTION SYSTEM



produces larger air-filled droplets, resulting in less drift

15° ATTACK ANGLE



Provides better crop canopy penetration
Make sure the spray from the tip is not colliding with the sprayer parts

IMPROVED PRODUCTIVITY



Provides exceptional balance in drift control, coverage and canopy penetration

MAXIMUM DRIFT CONTROL



Air induction Turbo droplets promote maximum drift control resulting in the lowest % of driftable fines

LOWER ENVIRONMENTAL CONTAMINATION RISK



by spray drift surrounding susceptible crops

TURBO TEEJET® INDUCTION (TTI)

TIP PART NO.	PSI									
	15	20	30	40	50	60	70	80	90	100
TTI11001	UC	UC	UC	XC	XC	VC	VC	VC	VC	C
TTI110015	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI11002	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI110025	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI11003	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI11004	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI11005	UC	UC	UC	XC	XC	XC	VC	VC	VC	VC
TTI11006	UC	UC	UC	XC	XC	VC	VC	VC	VC	C
TTI11008	UC	UC	UC	XC	XC	VC	VC	VC	VC	C
TTI11010	UC	UC	UC	XC	XC	VC	VC	VC	VC	C

Droplet size classification shown is based on ISO 25358. Droplet size classification standard is subject to change. Tabulations are based on spraying water at 70°F (21°C).



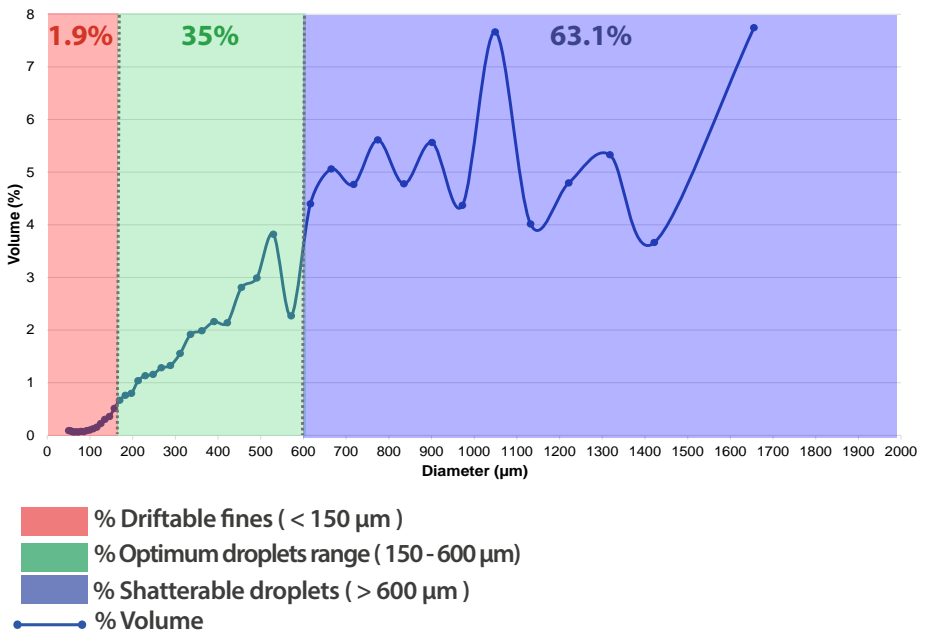
The TTI tip produces the coarsest droplet size category and the fewest driftable fines among the spray tips discussed in this chapter. For example, a TTI11004 at 40 PSI (2.8 bar) tested with water produced less than 2% driftable fines. When a 5 MPH (8 km/h) wind is added, we observe the most significant reduction in droplet dispersion compared to the images presented earlier for other tips.

Optimum Droplet Size

The TTI spray tip distinguishes itself by producing the coarsest droplet size range among the other spray tips presented before. To accurately represent this data, a 1.5% scale increase was necessary on the graphic's axis, as illustrated in the image below. When the TTI11004 operated at 40 PSI, only 1.9% of the droplets are classified as driftable fines. Notably, 35% of the droplets fall within the optimum droplet size range. 63.1% of the droplets are classified as shatterable; however, the incorporation of air into the droplets likely enhances their effectiveness by improving adherence to the target surfaces. Instead of shattering upon reaching the target, the air-filled droplets break into much smaller droplets that facilitate the retention of the pesticide solution at the intended location.

The Venturi air induction system is pivotal in reducing the number of droplets prone to drift, optimizing the proportion of droplets within the ideal size range, and minimizing the loss due to shatter. This feature makes the TTI tip an excellent choice for applying systemic herbicides targeting specific crops, ensuring that the right amount of product reaches the intended target with minimal environmental impact.

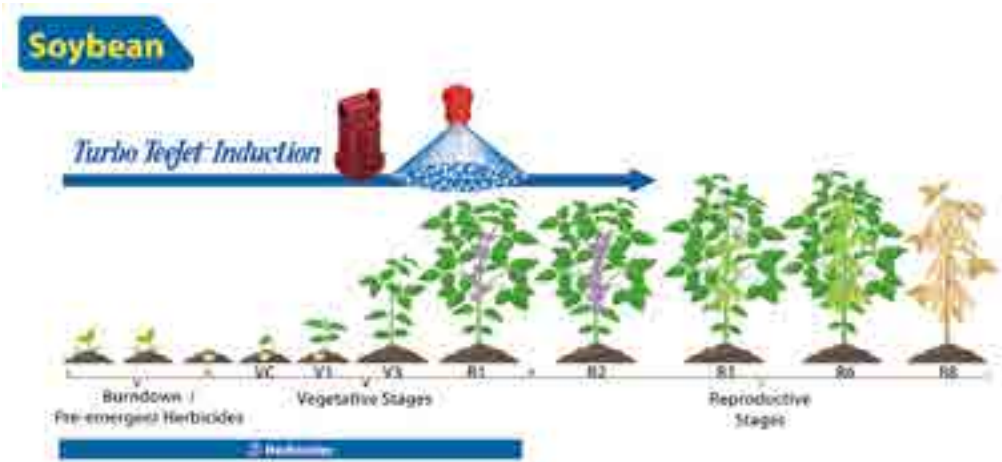
Percentage of droplets distributed by diameter frequencies of TTI11004 at 40 PSI (2.8 bar)



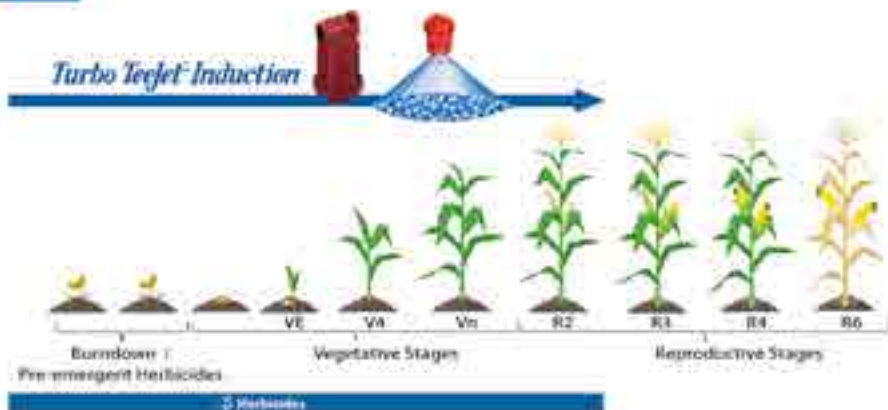
Applications of TTI

The TTI spray tip is well-suited for applying systemic herbicides, such as dicamba, during various stages of crop growth, including burndown applications, pre-emergence, and post-emergence.

The TTI spray tip stands out for its unique performance, delivering maximum drift control with less than 2% of driftable fines. This exceptional drift control ensures that the pesticide stays on target, significantly minimizing environmental impact and reducing waste. Importantly, the TTI tip maintains excellent coverage, providing the ideal conditions for effective weed control. This performance makes it a superior choice compared to similar spray tips on the market.



Corn



Cotton



Wheat



5

Summary

Following pesticide label recommendations for spray tip selection and application is important to ensure the safe use of pesticide and avoid breaking the law. Selecting the appropriate spray tip that produces the ideal droplet size range plays a pivotal role in achieving the desired outcome by delivering the optimal droplet size and dose, these spray tips ensure accurate coverage, effective reach to the target, and significantly minimize environmental impact. This highlights the importance of precision and compliance in agricultural practices, emphasizing the need for a thoughtful and informed approach to pesticide application to ensure both efficacy and environmental stewardship.



To summarize, the droplet size in spray applications are influenced by various factors, each playing a crucial role in determining the effectiveness and efficiency of pesticide application.

The choice of spray tip type, angle and capacity significantly impacts droplet size and distribution.

Pressure within the spray system influences droplet size, with higher pressures leading to finer atomization and smaller droplets. Additionally, the properties of the tank mixture, including viscosity, viscoelasticity, and surface tension, influence the energy required for spray atomization, through impacting droplet size.

Furthermore, the spray angle also affects droplet size, with wider angles typically resulting in smaller droplets due to a thinner initial web dispersion over a larger area.

It's important to note that the ideal droplet size range may vary depending on specific pesticide requirements, target, crop growth stage, and environmental conditions. Applicators must select the proper spray tip types, calibrate pressure accordingly before each application.

Adhering to pesticide label recommendations is very important for ensuring better product effectiveness and safety during application.

Overall, understanding and managing these factors are critical for optimizing pesticide applications, maximizing efficacy, and minimizing environmental impact.

TeeJet offers a wide range of spray tips designed to meet the specific needs of the most diverse applications, ensuring optimal performance and efficiency.

6

References

¹*A User's Guide to Spray Technology*. LI-TJ416, 2023.

²*An Engineer's Practical Guide to Drop Size*. Schick, R.J. Spraying Systems Co. Bulletin No. 459, 1997.

³American Society of Agricultural and Biological Engineers (ASABE) *S572.1: Spray nozzle classification by droplet spectra*. St. Joseph, Mich.: ASABE, 2009. 4p.

⁴American Society of Agricultural and Biological Engineers (ASABE) *S572.3: Spray nozzle classification by droplet spectra*. St. Joseph, Mich.: ASABE, 2020. 6p.

⁵International Standard. *Agricultural and forestry machinery - Inspection of sprayers in use - Part 2: horizontal boom sprayers*. (ISO 16122-2:2015).



SPRAYSELECT

SPRAY SOLUTIONS AT A



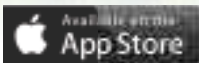
***SPRAYSELECT** allows you to quickly and easily choose the proper tip for your application.*



TIP SELECTION APP

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Just enter speed, spacing and your target rate, select your droplet size category and a list of top recommendations is provided.



FEATURES OF SPRAYSELECT



- *Select Application*

- *Find Spray Tips*

- *Tip Spacing*
- *Speed*
- *Application Rate*
- *Select Droplet Size*

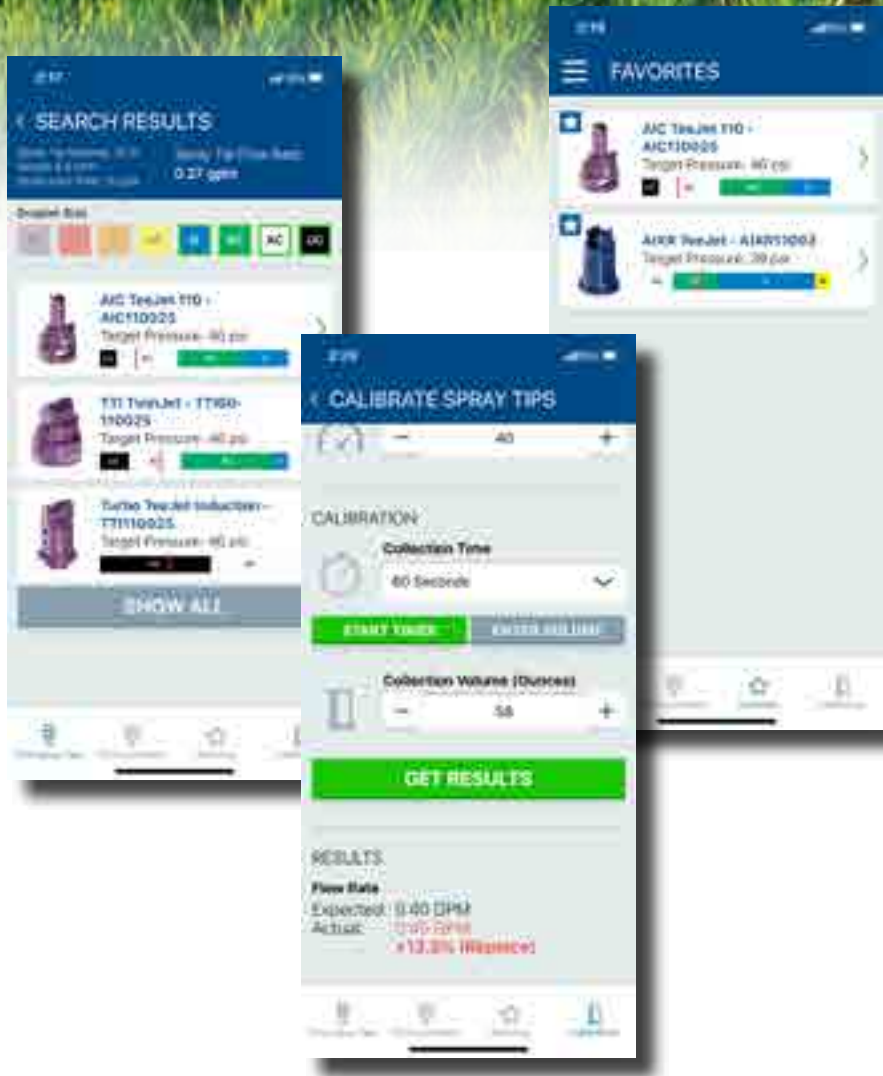
- *Save Favorites*

- *Spray Tip Calibration*

- *Find Distributors Nearby*

- *17 Languages*

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