



SAVE WATER, SAVE ENERGY  
and do a better job of irrigating.

rotator<sup>®</sup> technology

# IRRIGATION OF APPLES





R5

9 - 29 GPH  
34 - 110 LPH



R10

.3 - 1.1 GPM  
61 - 242 LPH



R10T

.6 - 2.1 GPM  
140 - 469 LPH



R2000

.7 - 3.5 GPM  
150 - 792 LPH



R2000LP

.88 - 5.0 GPH  
201 - 1144 LPH

## ROTATOR® SUCCESS

In the United States' Pacific Northwest region, Nelson Rotator® sprinklers are used in the production of at least 60% of the apple crop and over 85% of new apple orchards have Rotator sprinklers installed. The modern irrigated orchards of the Pacific Northwest produce quality and yields that exceed or meet those of any other apple producing area of the world. This is in part because of the conversion to the Rotator® and Full Coverage Irrigation from drip irrigation, impact sprinklers and micro sprays. The conversion began in 1987 with the introduction of the first Rotator model — the R20 (*no longer available — has been replaced by the R2000*). Today a full line of Orchard Rotator sprinklers from the R5 to the R2000LP are available and they can be applied to every production method and cultural practice to economically and effectively irrigate or cool apples.

Widespread adaptation to the Rotator® sprinkler in apple production can be attributed to many factors — some of which are listed below in their approximate order of relevance:

- **High uniformity**
- **Reliability**
- **Cooling**
- **Cover crop production and specific full coverage benefits in apples**



## HIGH UNIFORMITY

Some irrigation professionals conclude that the most uniform type of irrigation system for orchards is part coverage, drip or micro irrigation. **The R5 and R10 Rotators<sup>®</sup>, however, have demonstrated such high infield uniformity with full coverage application that they completely outperform traditional micro or drip irrigation systems for apple production.** Typically, low angle impact sprinklers produce poor uniformity by dumping excessive amounts of water in close. Because they have small nozzle size limitations, they are often spaced too wide as engineers strive to reduce application rates. **The introduction of the highly uniform R2000 Rotator<sup>®</sup>, a direct replacement for the impact sprinkler, has demonstrated a dramatic improvement in uniformity.**

High distribution uniformity in apple production is a result of many key variables, such as pressure, the emission device, sprinkler spacing, tree density/obstruction and wind exposure. Maintaining uniform pressure from sprinkler to sprinkler is a critical part of creating high uniformity.

**Table 1**  
**Pressure Range for Optimum Uniformity**

	PSI	BAR
R5	25-35	1.8-2.5
R10 & R10T	30-40	2.0-2.8
R2000	35-45	2.5-3.0
R2000LP	40-50	2.8-3.5

**Table 2**  
**Tree Density Suggestions for Under Tree Application of 9° Rotators in Apples**

	Trees per Acre (HA)	Distance Between Trees
R5	Any Number	Any Distance
R10 & R10T	Less than 650 (1,430/Ha)	More than 4 feet (1.2 M)
R2000	Less than 350 (770/Ha)	More than 8 feet (2.5 M)

The ideal operation pressure ranges for achieving high uniformity differ between Rotator models. This is shown in Table 1. To best deal with tree obstruction, Rotator density should increase as tree density increases. As tree density increases it is normally best to switch to smaller Rotator models; however, the smaller models such as the R5 can be used in both low and high density orchards.

Table 2 provides some general suggestions of when to switch to smaller Rotator models as tree

Wednesday, May 04, 2005

<b>Sprinkler:</b>	R10 ROTATOR	<b>Spacing:</b>	28.00 x 13.00 ft	<b>CU:</b>	87.4%
<b>Model:</b>	P2 9	<b>Layout:</b>	TriA	<b>DU:</b>	81.2%
<b>Trajectory:</b>	9°	<b>Theor. Precip:</b>	0.11 in/hr	<b>SC (95):</b>	1.2 (2)
<b>Nozzle:</b>	#50 DARK GREEN		51.5 gpm/acre	<b>Mean Precip.:</b>	0.11 in/hr
<b>Pressure:</b>	35.00 psi	<b>% Overlap:</b>	99%	<b>Min Precip.:</b>	0.08 in/hr
<b>Flow:</b>	0.43 gpm	<b>Area/Sprinkler:</b>	364.00 ft <sup>2</sup>	<b>Max Precip.:</b>	0.15 in/hr
<b>Riser Ht:</b>	12.00 in	<b>Tree Spacing:</b>	7.00 x 13.00 ft	<b>Tree Diameter:</b>	6.00 ft
<b>Mins/Rev:</b>	.17	<b>Tree Layout:</b>	Rect	<b>Strip Width:</b>	
<b>Stream Ht:</b>	0.00 ft				
<b>Record #:</b>	3011-NA				
<b>Offset:</b>	14.00 ft				

	CU	DU	SC (95)	Mean	Precipitation Min	Max	% Water
Strips	89.4%	85.3%	1.2	0.12 in/hr	0.10 in/hr	0.15 in/hr	33.3
Trees							

**% Overlap: 99%**

Precipitation in/hr — 0.05 - 0.09 — 0.09 - 0.12 — 0.12 - 0.15

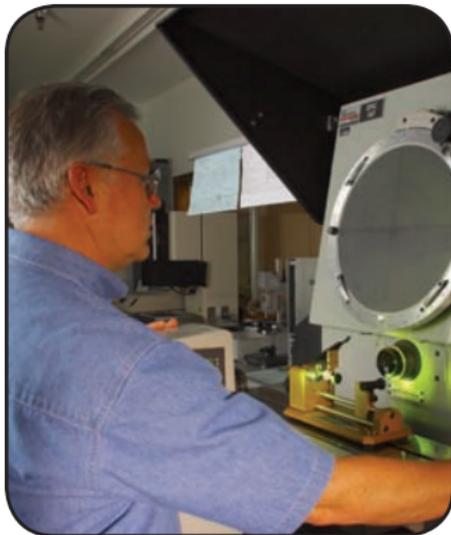
CENTER • Sprinkler • Tree - - - - Root zone



*Example of  
Overlap Analysis*

density increases. Systems with sprinklers in every tree row normally counter the effects of tree obstruction best. Use the Nelson Overlap\* software to calculate uniformity and % overlap. To avoid coverage problems caused by wind drift and to counter the effects of obstruction, always select spacings with 90% or more overlap. Select 100% overlap or higher when using flow control nozzles, in tree densities greater than 1,000 per acre (2,200/Ha), on slopes greater than 5% and in known high wind conditions [more than 6 mph (10 kph) during all irrigation].

\* Contact factory for information on how to purchase Overlap software.



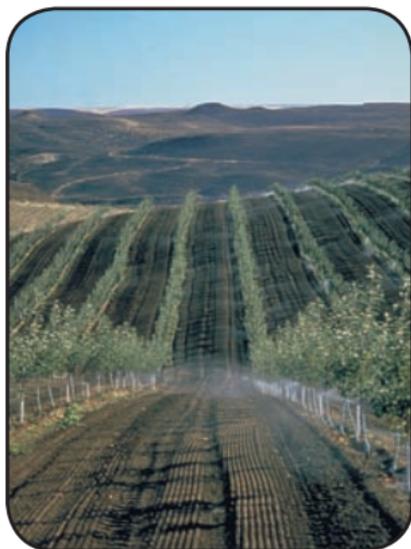
## RELIABILITY

The Rotator® product line has long been known for reliability. Rotator technology is enhanced with high-tech design techniques, automated assembly and state-of-the-art testing by highly-trained quality assurance professionals and the best equipment available. The products are engineered to last in demanding agriculture conditions (i.e. dirty water). Reliability is a “show me, don’t tell me” kind of

feature. The consistent conversion to Rotators away from drip, micro sprinklers and impact sprinklers speaks to the reliability of the Rotator. It requires less maintenance and is easier to repair, which makes it far superior to these other products, especially when the increasing cost of labor becomes an issue.

## COVER CROP & FULL COVERAGE BENEFITS

In apple production, cover crops (which are normally low growing grasses) provide several essential benefits. They **reduce soil erosion** during rains or wind storms. They **cool** the general orchard environment. They **improve infiltration** of irrigation and eliminate ponding. They **reduce compaction**, and improve soil aeration and tilth. They **provide stability** to the orchard floor, making machine passage more feasible right after cooling, frost control, irrigation or rainfall. They **provide habitat for some beneficial insects**.

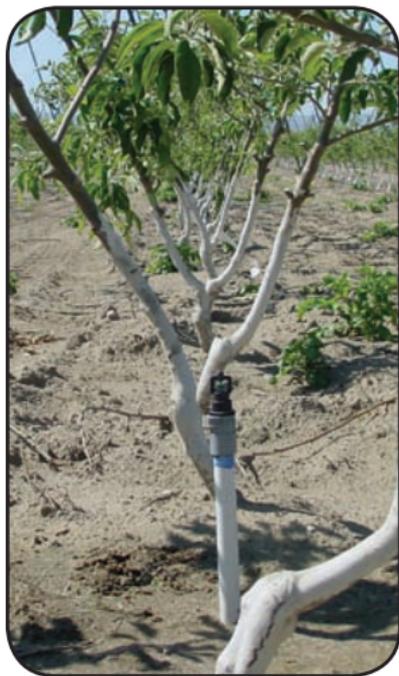


*The addition of a cover crop on this site prevented major erosion caused by rain storms.*

Many apple growers have observed that drip systems are very effective in the first 1 to 3 years of an apple orchard. After the 3rd year, an overwhelming number of growers who originally thought the drip system would always be the primary irrigation source for the orchard then recognize that production and tree vigor are improved in older trees with full coverage irrigation. This may be in part because apple trees by nature have root systems that spread to an area 1.5 to 2.5 times the area under the drip line of the tree. When drip irrigation is used, it is sometimes used in conjunction with Rotator systems for the purpose of cover crop maintenance, cooling and frost control. Past experience has shown many times that even for these more limited

purposes a high uniformity system should be installed from the beginning, because the Rotator system is utilized far more than originally intended.

Full coverage irrigation in combination with growing a cover crop improves the nutrition of many soils, particularly with plant nutrients like Phosphorus and Potassium that are released from the decomposition of organic matter produced by the cover crop. Full coverage irrigation increases the microorganism activity in the soil and the expanse of the root system. This creates a larger soil reservoir from which nutrients can be mined.



*In this 90 acre (36 ha) high density apple orchard, there are 2,074 trees/acre (5,123/ha). There are 195 R5 Rotators per acre (480/ha). The R5 Rotator provides full coverage with 110% overlap and a DU of 91%. The application rate is a low .10 in/hr (2.5 mm/hr.)*

## LOWER APPLICATION RATES

A primary benefit of lower application rates is a reduction of system cost. Lower application rates improve soil infiltration and reduce run off and erosion, particularly in undulating terrain. Low application rates improve



soil aeration, which in turn improves root development and general tree vigor. Lower application rates are defined in the range of 0.065 to 0.10 inch/hr (1.6 to 2.5 mm/hr). Extreme caution should be taken to avoid moisture stress when using low application rates as evaporative losses may increase and the potential of wind distortion increases. High uniformity is essential — sprinkler layouts with overlap less than 100% may cause problems. More frequent and longer irrigation durations are required to meet crop needs

and counter evaporative losses. The flow and radius performance of the R5 and R10 Rotators are most ideally suited for lower application rates in under tree irrigation of apples.

## COOLING

Overhead cooling of apples increases color, improves storage life, and when properly done, prevents sun scald and sun burn. In addition cooling can increase total photosynthesis, which in turn increases productivity. Those who are the most successful with cooling use automation to accurately cycle zones on and off multiple times a day, they intensively manage the start time of day and stop time according to weather conditions, they select



*Cooling can increase red color, prevent sun burn /scald and improve storage life.*

adequate application rates [ideal is in the range of 0.09 to 0.12 inch/hr (2.3 to 3.0 mm/hr)], they treat water to reduce calcium carbonate buildup on the fruit, and above all they install Rotator systems with high uniformity.



*Poor uniformity often leaves pockets of lightly sun burned fruit.*

High Uniformity is essential to cooling for two reasons. First, the most effective cooling is accomplished by wetting the surfaces that need to be cooled such as fruit or leaves and limbs. The evaporation of the water on those surfaces removes heat as the liquid form of water converts to a gas. When the water is applied uniformly, cooling is more effective during periods of high heat, and the percentage of fruit

damaged from sun burn is reduced. Secondly, a percentage of the water being applied does reach the ground and thus becomes irrigation that in turn affects the uniformity of fruit size and tree vigor. Application rates that are too low do not prevent sunburn or sunscald in periods of high heat and they are more likely to create excessive calcium carbonate buildup. Application rates that are too high or failure to use cycling can result in excessive irrigation, which over saturates the soil and in turn reduces crop vigor.

### **Rotator® Applications for Cooling**

All the Rotator models have been successfully used for cooling. No vibration, reliability and high uniformity are the most important Rotator benefits for cooling systems. Although they create no vibration, Rotators do create a back thrust which should be stabilized with a mounting apparatus that secures the Rotator in a plumb upright position.



*Cooling with water that contains high levels of Ca, Mg, Na salts or bicarbonates cause leaf burn. Using application rates below .11 in/hr (2.8 mm/hr) significantly increases the problem.*



*Ease of mounting, high uniformity, and reliability are features that make Rotators very attractive cooling sprinklers.*

The lack of vibration significantly reduces the cost of the mounting apparatus required when compared to impact sprinklers, and also reduces maintenance cost because no pipes or fittings are worn as a result of vibration. Vibration also reduces reliability and uniformity. Reliability becomes more important when access to each sprinkling device requires a ladder. Filtration for cooling systems should always be adequate to prevent high labor costs and safety risks of unplugging sprinklers from a ladder.

When the R2000 and R2000LP Rotators are selected for cooling, fewer devices per acre (hectare) are required, which in turn reduces filtration and general operational costs. The R10 and R10T have the ideal rotation speed and droplet size for cooling. Rotation speeds range from 12 to 36 seconds depending on the configuration of R10 or R10T and the operation pressure. Spinning or faster rotating devices (than Rotators) create smaller droplets which evaporate before reaching leaf or fruit surfaces. When cycling zones on and off, rotation speeds in the range of 12 to 36 seconds quickly wet and rapidly restart the cooling process. The R5 is a good option for cooling when available pressure is lower — in the range of 15 to 30 PSI (1 to 2 BAR). To maintain high uniformity in most cooling conditions, Rotators should be spaced such that there is 90 to 100% overlap. Use the Nelson Overlap software and indoor test data to calculate % overlap.



## PRESSURE REGULATOR / DRAIN CHECK



*Mini  
Regulator*



*Mini  
Regulator  
Drain Check*



*Drain  
Check*

The **Mini Regulator (MR)** is a pressure regulator only. It is a normally open device that reduces higher inlet pressures down to its nominal pressure.

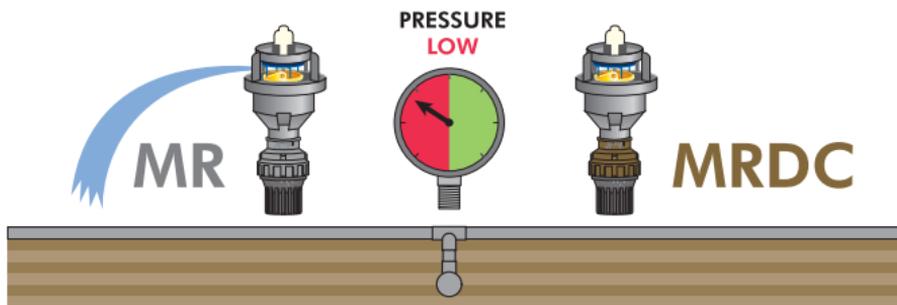
The **Mini Regulator Drain Check (MRDC)** is a combination regulator and check valve. It is the ideal option when a check feature is required and the required minimum inlet pressure is certain to be available in the system. Pressure regulation enables the highest potential Distribution Uniformity because it delivers consistent spray patterns, and equal emission rates at each sprinkling device.

The **Mini Drain Check (MDC)** is a check valve only. It opens once the inlet pressure reaches the nominal check pressure. This option is ideal when flow control nozzles are used, or when there is uncertainty as to the consistency of inlet pressures.



## DRAIN CHECK FOR COOLING

The MDC or MRDC should be used when cooling systems are cycled on and off many times each day. With these check valves in place, systems come up to operating pressure almost instantly. Low head system drainage and low pressure start up run periods are eliminated. Water use efficiency can be increased by as much as 25%.



*How they work:* The MRDC and MDC are normally closed devices. The check will not open until a certain minimum inlet pressure is reached. The minimum pressure to open an MRDC is approximately 75% of nominal pressure, and approximately 90% of the nominal pressure for the MDC. Exact regulation with an MRDC will not take place until the inlet pressure is at or above the nominal pressure. Provide 5 PSI above the nominal pressure for the most accurate pressure regulation.

*The MRDC and MDC are not designed for operation below freezing. Remove them and drain the irrigation pipes during freezing conditions to prevent damage to the system. These products are not recommended for use in freezing conditions.*

## ROTATOR SPECIFIC PRODUCT FEATURES

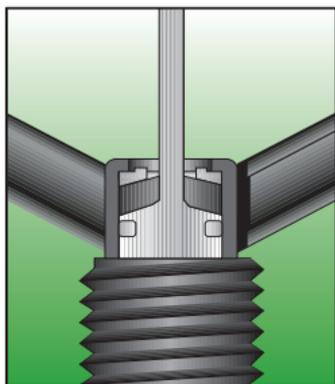
All Rotator models feature color-coded nozzles for quick and easy size identification. Quick change 2TN nozzles and acme thread connections in the R10, R10T, R2000 and R2000LP

2TN Nozzles

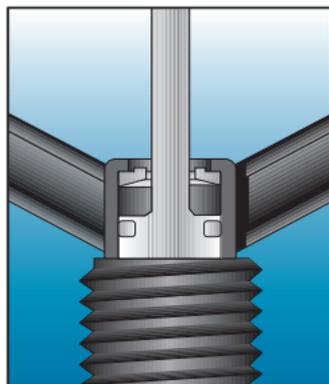


R10 with Mini Regulator

make nozzle cleaning or changing simple and quick. Flow control nozzles or the mini regulator allow the application of Rotators on undulating terrain. A road guard adapter is very widely used for half circle applications. A full line of feedtube assemblies are available for quick simple connection to polyethylene laterals. A full line of accessories fulfills many special application needs such as mounting to a trellis or extending risers.



**Flow Control Nozzle  
with high pressure**



**Flow Control Nozzle  
with low pressure**

*How it works:* The nozzles illustrated above are operating at the same flow. As pressure increases, the flexible flow washers reduce the orifice opening size giving a constant flow over a wide range of pressure. They assure uniform application of water throughout your crop.



Road guards easily snap on to convert the R10 and R2000 series Rotators to part-circle operation (irrigates 200°). Cutting guides are provided at 10° increments to increase the amount of arc irrigated.



*The FT2 Feedtube Assembly with an R10 Rotator*



*The FT4 Feedtube Assembly with an R10 Turbo*

*The Nelson Flush Tool (for 2000 Series Rotators) can be used to disconnect and reconnect the sprinkler for nozzle cleaning while under pressure without getting the irrigator soaked. In addition, the top of the flush tool will disengage the Rotator® motor from the cap for changing or replacing the diffuser, cap or motor.*



## APPLICATION CHART FOR UNDER TREE IRRIGATION OF APPLES WITH R5 ROTATOR

(R5 Rotator® with green 9° plate, application rate for all layouts is .09 inch/hr, 2.3 mm/hr)

TREES (FEET)		TREES (METERS)		SPRINKLER SPACING	
Trees <sup>1</sup>	Rows <sup>2</sup>	Trees <sup>3</sup>	Rows <sup>4</sup>	R5 <sup>5</sup>	Pipes <sup>6</sup>
1	10	0.3	3.1	28	10
1	12	0.3	3.7	24	12
1	14	0.3	4.3	20	14
2	10	0.6	3.1	28	10
2	12	0.6	3.7	24	12
2	14	0.6	4.3	20	14
5	13	1.5	4.0	20	13
5	15	1.5	4.6	20	15
6	13	1.8	4.0	24	13
6	15	1.8	4.6	18	15
7	14	2.1	4.3	14	14
7	16	2.1	4.9	14	16
8	16	2.4	4.9	16	16
9	18	2.7	5.5	18	18
10	20	3.1	6.1	20	20

1. Distance between trees going down the row in feet.
2. Distance between rows in feet, width of drive alley way.
3. Distance between trees going down the row in meters.
4. Distance between rows in meters, width of drive alley way.
5. Distance between R5 Rotators going down the pipe or row in feet (triangular layout).
6. Distance between pipes in feet.

Please contact the factory for application charts for the other Rotator products.

SPRINKLER SPACING		% Overlap	PRESSURE		Nozzle	DU <sup>9</sup>
R5 <sup>7</sup>	Pipes <sup>8</sup>		PSI	BAR		
8.5	3.1	100	26	1.8	#45	89.0
7.3	3.7	108	28	1.9	#45	90.0
6.1	4.3	116	26	1.8	#45	90.0
8.5	3.1	100	26	1.8	#45	89.0
7.3	3.7	108	28	1.9	#45	90.0
6.1	4.3	116	26	1.8	#45	90.0
6.1	4.0	102	36	2.5	#40	88.0
6.1	4.6	100	30	2.1	#45	89.0
7.3	4.0	95	33	2.3	#45	87.0
5.5	4.6	102	38	2.6	#40	84.0
4.3	4.3	108	24	1.7	#40	84.0
4.3	4.9	100	27	1.9	#40	84.0
4.9	4.9	110	35	2.4	#40	88.0
5.5	5.5	96	35	2.4	#45	91.0
6.1	6.1	87	35	2.4	#50	86.0

7. Distance between R5 Rotators going down the pipe or row in meters.
8. Distance between pipes in meters.
9. Distribution Uniformity.

## WARRANTY AND DISCLAIMER

Nelson Rotator® Sprinklers, Feedtube Assemblies and accessories are warranted for one year from the date of original sale to be free of defective material and workmanship when used within the working specifications for which the products were designed and under normal use and service. The manufacturer assumes no responsibility for installation, removal or unauthorized repair of defective parts and the manufacturer will not be liable for any crop or other consequential damages resulting from any defects or breach of warranty. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSES AND OF ALL OTHER OBLIGATIONS OR LIABILITIES OF MANUFACTURER. No agent, employee or representative of the manufacturer has authority to waive, alter or add to the provisions of this warranty nor to make any representations or warranty not contained herein.

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