



RNA isolation from plant and fungi

User manual

NucleoSpin[®] RNA Plant and Fungi

May 2018 / Rev. 03

RNA isolation from plant and fungi

Protocol at a glance (Rev.03)

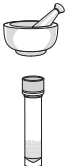
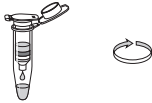
NucleoSpin® RNA Plant and Fungi		
1 Homogenize and lyse sample		500 µL PFL 10–50 µL PFR Mix 56 °C, 5 min 14,000 x g, 1 min
2 Filtrate lysate		Load lysate 14,000 x g, 1 min
3 Adjust RNA binding conditions		500 µL PFB Mix RT, 5 min
4 Bind RNA		Load 650 µL sample 14,000 x g, 30 s Load residual sample 14,000 x g, 30 s
5 Wash silica membrane		1 st wash 500 µL PFW1 2 nd wash 500 µL PFW2 3 rd wash 500 µL PFW2 14,000 x g, 1 min after each washing step
6 Elute RNA		50 µL RNase-free H ₂ O RT, 1 min 14,000 x g, 1 min

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1 Components

1.1 Kit contents

NucleoSpin® RNA Plant and Fungi			
REF	10 preps 740120.10	50 preps 740120.50	250 preps 740120.250
Lysis Buffer PFL	8 mL	30 mL	150 mL
Reduction Buffer PFR	5 mL	5 mL	20 mL
Binding Buffer PFB	10 mL	45 mL	200 mL
Wash Buffer PFW1	8 mL	30 mL	150 mL
Wash Buffer PFW2 (concentrate)*	6 mL	25 mL	3 x 25 mL
RNase-free H ₂ O	13 mL	13 mL	60 mL
NucleoSpin® RNA Plant and Fungi Filter	10	50	250
NucleoSpin® RNA Plant and Fungi Columns (light blue rings – plus Collection Tube)	10	50	250
Collection Tubes (2 mL)	30	150	750
Collection Tubes (1.5 mL)	10	50	250
User Manual	1	1	1

* For preparation of working solutions and storage, see section 3.

1.2 Reagents, consumables, and equipment to be supplied by user

Reagents

- 96–100 % ethanol (for preparation of Buffer PFW2)
- Neutralization Buffer PFN for processing acidic samples (see section 6.3 for ordering information)

Consumables

- Disposable pipette tips
- NucleoSpin® Bead Tubes Type G (optional, see section 6.3 for ordering information)

Equipment

- Manual pipettes
- Centrifuge for microcentrifuge tubes
- Equipment for sample disruption and homogenization (see section 2.4)
- Personal protection equipment (lab coat, gloves, goggles)

1.3 About this user manual

It is strongly recommended for first time users to read the detailed protocol sections of the **NucleoSpin® RNA Plant and Fungi** kit before using this product. Experienced users, however, may refer to the Protocol at a glance instead. The Protocol at a glance is designed to be used only as a supplemental tool for quick referencing while performing the purification procedure.

All technical literature is available online at **www.mn-net.com**.

Please contact Technical Service regarding information about any changes to the current user manual compared with previous revisions.

2 Product description

2.1 The basic principle

The **NucleoSpin® RNA Plant and Fungi** kit is designed for the isolation of RNA from diverse plant and fungal material, including samples rich in starch, sugar, secondary metabolites and other compounds that might interfere with common RNA isolation procedures.

First, plant material is mechanically disrupted (e.g., by NucleoSpin® Bead Tubes, grinding in liquid nitrogen, or any other suitable disruption method) in lysis buffer containing large amounts of chaotropic ions. This lysis buffer immediately inactivates RNases, which are present in virtually all biological materials. After removal of plant debris with the NucleoSpin® Plant and Fungi Filter, a binding solution is added which creates appropriate binding conditions which favor adsorption of RNA to the silica membrane. Washing steps with two different buffers remove salts, metabolites and macromolecular cellular components. Pure RNA is finally eluted under low ionic strength conditions with RNase-free water.

The RNA preparation using **NucleoSpin® RNA Plant and Fungi** can be performed at room temperature. The eluate, however, should be treated with care because RNA is very sensitive to trace contaminations of RNase, often found on general lab ware, fingerprints, and dust. To ensure RNA stability, keep RNA frozen at -20 °C for short-term or at -70 °C for long-term storage.

2.2 Kit specifications

- **NucleoSpin® RNA Plant and Fungi** is recommended for the isolation of RNA from diverse plant tissues and organs as well as filamentous fungi. The kit is not suitable for the isolation of small RNA (< 200 nt).
- Typically, 50–500 mg sample input is recommended per preparation. Please refer to Table 2 (page 11, f) for detailed recommendations.
- **NucleoSpin® RNA Plant and Fungi Filters** for removal of tissue debris are included in the kit.
- The kit allows the isolation of up to 70 µg RNA, suitable for downstream applications such as qRT-PCR, cDNA synthesis, Northern blotting and others.

Table 1: Kit specifications at a glance

Parameter	NucleoSpin® RNA Plant and Fungi
Format	Mini spin column
Sample material	< 500 mg plant / fungal material
Fragment size	> 200 nt
Typical yield	20–70 µg
A_{260}/A_{280}	1.9–2.1
A_{260}/A_{230}	~ 2
Typical RIN (RNA Integrity Number)	7–9
Elution volume	50 µL
Preparation time	25 min/6 preps
Binding capacity	200 µg

2.3 Handling, preparation, and storage of starting materials

RNA is not protected against digestion by plant RNase until the sample material is flash frozen or disrupted in the presence of RNase inhibiting or denaturing agents. Therefore it is important that samples are processed as fresh as possible or flash frozen in liquid N₂ immediately and stored at -70 °C. If frozen samples are used as sample material, it is very important that the sample will only thaw during the mechanical disruption in the presence of lysis buffer. Otherwise the RNA quality will be immediately impaired.

Plant material lysed in Lysis buffer PFL can be stored at -20 °C for at least 2 weeks.

Wear gloves at all times during the preparation. Change gloves frequently.

2.4 Lysis and disruption of sample material

For most plant sample material a mechanical disruption is a necessity. Several disruption options are possible.

Mortar, pestle and liquid nitrogen

This common sample disruption method can be used for most sample types. It typically gives excellent RNA quality; however, RNA yield can be lower compared to the extraction with bead tubes or extraction bags (see below).

Bead tubes

NucleoSpin® Bead Tubes Type G (see section 6.3 for ordering information) are recommended in combination with a swing-mill (e.g., MM200, MM300, MM400

(Retsch®) for most plant materials. Bead Tubes typically give highest yield, avoid any cross-contamination, and enable time efficient sample disruption.

The MN Bead Tube Holder should not be used for disruption of plant material with NucleoSpin® Bead Tubes Type G because it is usually insufficient.

2.5 Elution procedures

It is possible to adapt the elution method and elution volume in order to achieve optimal RNA concentrations for the respective downstream application. In addition to the standard method described in the individual protocols (recovery rate about 70–90 %), modifications are possible.

- **High yield:** Perform two elution steps with the volume indicated in the individual protocol. About 90–100 % of bound nucleic acid will be eluted.
- **High yield and high concentration:** Elute with the standard elution volume and apply the eluate once more onto the column for re-elution.

Eluted RNA should immediately be kept on ice for optimal stability. For short-term storage freeze at -20 °C, for long-term storage freeze at -70 °C.

3 Storage conditions and preparation of working solutions

Attention: Buffers PFL and PFW1 contain chaotropic salt. Wear gloves and goggles!

CAUTION: Lysis Buffer contains guanidine hydrochloride which can form highly reactive compounds when combined with bleach (sodium hypochlorite). DO NOT add bleach or acidic solutions directly to the sample-preparation waste.

All kit components should be stored at room temperature (18–25 °C) and are stable for at least one year. Storage at lower temperatures may cause precipitation of salts.

During storage, especially at low temperatures, a precipitate may form in Buffer PFN. Such precipitates can be easily dissolved by incubating the bottle at 40 °C before use.

Before starting any NucleoSpin® RNA Plant and Fungi protocol prepare the following:

Wash Buffer PFW2: Add the indicated volume of 96–100 % ethanol (see table below) to Wash Buffer PFW2. Mark the label of the bottle to indicate that ethanol was added. Wash Buffer PFW2 can be stored at room temperature (18–25 °C) for at least one year.

NucleoSpin® RNA Plant and Fungi			
REF	10 preps 740120.10	50 preps 740120.50	250 preps 740120.250
Wash Buffer PFW2 (concentrate)	6 mL Add 24 mL ethanol	25 mL Add 100 mL ethanol	3 x 25 mL Add 100 mL ethanol to each bottle

4 Safety instructions

The following components of the **NucleoSpin® RNA Plant and Fungi** kit contain hazardous contents.

Wear gloves and goggles and follow the safety instructions given in this section.

Only harmful features do not need to be labeled with H and P phrases up to 125 mL or 125 g.
Mindergefährliche Eigenschaften müssen bis 125 mL oder 125 g nicht mit H- und P-Sätzen gekennzeichnet werden.

Component	Hazard contents	GHS symbol	Hazard phrases	Precaution phrases
Inhalt	Gefahrstoff	GHS-Symbol	H-Sätze	P-Sätze
PFL	Guanidine hydrochloride 36–50 % <i>Guanidinhydrochlorid 36–50 %</i> CAS 50-01-1	 WARNING <i>ACHTUNG</i>	302, 319	264W, 280sh, 301+312, 330
PFB	Lithium chloride 40–70 % <i>Lithiumchlorid 40–70 %</i> CAS 7447-41-8	 WARNING <i>ACHTUNG</i>	302, 315, 319	264W, 280sh, 301+312, 330

Hazard phrases

- H 302 Harmful if swallowed.
Gesundheitsschädlich bei Verschlucken.
- H 315 Causes skin irritation.
Verursacht Hautreizungen.
- H 319 Causes serious eye irritation.
Verursacht schwere Augenreizung.

Precaution phrases

- P 264W Wash with water thoroughly after handling..
Nach Gebrauch mit Wasser gründlich waschen.
- P 280sh Wear protective gloves / eye protection.
Schutzhandschuhe / Augenschutz tragen.
- P 301+312 IF SWALLOWED: Call a POISON CENTER / doctor if you feel unwell.
BEI VERSCHLUCKEN: Bei Unwohlsein GIFTINFORMATIONSZENTRUM / Arzt anrufen.
- P 330 Rinse mouth.
Mund ausspülen.



The symbol shown on labels refers to further safety information in this section.
Das auf Etiketten dargestellte Symbol weist auf weitere Sicherheitsinformationen dieses Kapitels hin.

For further information please see Material Safety Data Sheets (www.mn-net.com).
Weiterführende Informationen finden Sie in den Sicherheitsdatenblättern (www.mn-net.com).

5 Protocols

Please refer to Table 2 for choosing the optimal protocol, sample amount and buffer volumes.

Table 2: Recommendations for different sample types

	Sample amount per preparation	Buffer PFR	Buffer PFB	Recommended protocol
Samples rich in secondary metabolites				
Grape vine leaf	100 mg	50 µL	500 µL	5.1
Noble fir	50 mg	20 µL	500 µL	5.1
Spruce needle	50 mg	20 µL	500 µL	5.1
Ginger rhizome	500 mg	50 µL	500 µL	5.1
Fruit tissue				
Kiwi	500 mg	20 µL	750 µL	5.2
Citrus fruit	500 mg	20 µL	750 µL	5.2
Apple	500 mg	10 µL	750 µL	5.2
Grape berry	500 mg	50 µL	750 µL	5.1
Blueberry	500 mg	20 µL	500µL	5.2
Tomato	500 mg	20 µL	750 µL	5.1
Leaves				
Tobacco	100 mg	50 µL	500 µL	5.1
Wheat	100 mg	20 µL	500 µL	5.1
Maize	100 mg	20 µL	500 µL	5.1
<i>Arabidopsis</i>	100 mg	20 µL	500 µL	5.1
Samples with high starch content				
Maize kernel	100 mg	50 µL	500 µL	5.1
Wheat kernel	90 mg	20 µL	500 µL	5.1
Potato tuber	50 mg	50 µL	500 µL	5.1

Table 2: Recommendations for different sample types

	Sample amount per preparation	Buffer PFR	Buffer PFB	Recom- mended protocol
Other seeds				
<i>Arabidopsis</i> seeds	100 seeds	20 µL	750 µL	5.1
Alfalfa seed	50 mg	20 µL	750 µL	5.1
Cotton seed	1 seed (~100mg)	20 µL	750 µL	5.1
Roots				
Alfalfa root	300 mg	10 µL	500 µL	5.1
Pea root	180–280 mg	20 µL	500 µL	5.1
Sugar beet (root)	500 mg	10 µL	500 µL	5.1
Other sample types				
Sugar cane (stem)	500 mg	20 µL	500 µL	5.1
Fungal hyphae	50 mg	20 µL	750 µL	5.2
Fungal fruiting body	50–100 mg	10 µL	500 µL	5.1
Moss	100 mg	10 µL	500 µL	5.1

5.1 RNA isolation from plant and fungal material

Before starting the preparation:

- Check if Wash Buffer PFW2 was prepared according to section 3.
- During storage, especially at low temperatures, a precipitate may form in Buffer PFN. Such precipitates can be easily dissolved by incubating the bottle at 40 °C before use.

1 Homogenize sample

Option A: Mortar, pestle, and liquid nitrogen

Add **500 µL Buffer PFL** into a 1.5 or 2 mL microcentrifuge tube (not provided).

Add **10–50 µL Buffer PFR** to the tube. See table 2 for optimal volume of Buffer PFR.

Precool mortar and pestle with liquid nitrogen or at -70 °C in a freezer.

Add the sample into the mortar containing liquid nitrogen. For optimal sample input, follow the recommendations given in Table 2.

Grind sample under liquid nitrogen until a fine powder is obtained.

Transfer sample to the Buffer PFL/PFR mixture and mix immediately. The plant material shall only thaw within the lysis buffer.

Incubate lysis tube for **5 min** at **56 °C**.

Note: Do not perform this heat incubation for samples with high starch content, e.g., potato tubers or wheat kernel.

Centrifuge for **1 min** at **14,000 x g** in order to sediment cell debris.

Note: If the cell debris pellet is not sufficiently solid, centrifuge for a longer time (e.g., 3 min) and/or at 20,000 x g.

Continue with the clear supernatant.



500 µL PFL
10–50 µL PFR
Mix



Grind sample



Transfer sample
56 °C, 5 min



14,000 x g,
1 min

Option B: Bead Tubes (not provided)

Add **500 µL Buffer PFL** into **NucleoSpin® Bead Tubes Type G**.

Add **10–50 µL Buffer PFR** to the tube. See table 2 for optimal volume of Buffer PFR.

Transfer sample to the NucleoSpin® Bead Tube Type G. For optimal sample input, follow the recommendations given in table 2.

Place the Bead Tube into a swing-mill and **agitate twice** for **30 s** at 30 Hz with intermediate position change (please refer to the manufacturers' instructions for proper use of the instrument).

Incubate NucleoSpin® Bead Tube Type G for **5 min** at **56 °C**.

Note: Do not perform this heat incubation for samples with high starch content, e.g., potato tubers or wheat kernel.

Remove steel balls from the Bead Tube.

! *Attention: Removal of steel balls is necessary in order to avoid tube damage during subsequent centrifugation.*

Centrifuge for **1 min** at **14,000 x g** in order to sediment cell debris.

Note: If the cell debris pellet is not sufficiently solid, centrifuge for a longer time (e.g. 3 min) and/or at 20,000 x g.

Continue with the clear supernatant.



500 µL PFL
10–50 µL PFR

**Transfer
sample**



**Agitate
2 x 30 s**

56 °C, 5 min



**14,000 x g,
1 min**

2 Filtrate Lysate

Insert a **NucleoSpin® RNA Plant and Fungi Filter Column** (green ring) into a Collection Tube (2 mL, provided).

Note: Alternatively use a 2 mL microcentrifuge tube with lid (not provided). This facilitates mixing by vortexing in step 3.

Load the clear **lysate** from step 1 onto the column.

Centrifuge for **1 min** at **14,000 x g**.

Note: In some cases a small pellet will form. This pellet does not have to be removed and can be processed together with the supernatant.

Note: If the sample does not pass the column completely, centrifuge at 20,000 x g for additional 3 min.



Load lysate



**14,000 x g,
30 s**

3 Adjust RNA binding conditions

Add **500 µL Buffer PFB** to the flowthrough and mix by pipetting.

Note: Please refer to Table 2 for recommendations on Buffer PFB increase for certain sample types.

Incubate for **5 min** at **room temperature**.



500 µL PFB

RT, 5 min

4 Bind RNA

For each preparation take one **NucleoSpin® RNA Plant and Fungi Column** (light blue ring) preassembled with a Collection Tube.

Load 650 µL of the sample onto the NucleoSpin® RNA Plant and Fungi column.

Centrifuge for **30 s** at **14,000 x g**.

Discard the flowthrough and reuse the collection tube.

Load the residual sample volume (approx. 200 µL) onto the column.

Centrifuge for **30 s** at **14,000 x g**.

Discard collection tube with flowthrough and insert the column into a fresh Collection Tube (2 mL, provided).



**Load 650 µL
sample**



**14,000 x g,
30 s**



**Load residual
sample**



**14,000 x g,
30 s**

5 Wash and dry silica membrane**1st wash**

Add **500 µL Buffer PFW1** onto the column.

Centrifuge for **1 min** at **14,000 x g**.

Discard collection tube with flowthrough and insert column into a fresh Collection Tube (2 mL, provided).



500 µL PFW1



**14,000 x g,
1 min**

2nd wash

Add **500 µL Buffer PFW2** onto the column.

Centrifuge for **1 min** at **14,000 x g**.

Discard flowthrough and reuse collection tube.



500 µL PFW2



**14,000 x g,
1 min**

3rd wash

Add **500 µL Buffer PFW2** onto the column.

Centrifuge for **1 min** at **14,000 x g**.

Discard flowthrough and discard collection tube unless the following additional wash step is included.



500 µL PFW2



**14,000 x g,
1 min**

Optional: For some samples an additional wash step is recommended. These samples cause a discoloring of the silica or the eluate after the 3rd washing step. Such samples are e.g., conifer needles, blueberry fruits, and grape leaves.

Add **500 µL Wash Buffer PFW2** onto the column.

Centrifuge for **1 min** at **14,000 x g**.

Discard collection tube with flowthrough.

6 Elute RNA

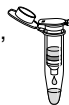
Insert column into a fresh Collection Tube (1.5 mL, provided).

Add **50 µL RNase-free H₂O** onto the column.

Incubate for approximately **1 min** at **room temperature**.

Centrifuge for **1 min** at **14,000 x g**.

If higher RNA concentrations are desired, elution can be done with 40 µL. Overall yield, however, will decrease when using smaller volumes.



**50 µL RNase-free
H₂O**

RT, 1 min



**14,000 x g,
1 min**

For further alternative elution procedures see section 2.5.

5.2 RNA isolation from acidic samples (e.g., fruits) and other samples

Before starting the preparation:

- Check if Wash Buffer PFW2 was prepared according to section 3.
- Check if Neutralization Buffer PFN is available (see section 6.3 for ordering information).

Table 3: Recommended volume of Buffer PFN

Sample type (fruit tissue)	Buffer PFN per preparation
Kiwi	50 µL
Lemon	50 µL
Apple	15 µL
Orange	15 µL
Blueberry	50 µL
Fungal hyphae	0–50 µL

1 Homogenize sample

Option A: Mortar, pestle, and liquid nitrogen

Add **500 µL Buffer PFL** into a 1.5 or 2 mL microcentrifuge tube (not provided).

Add **10–50 µL Buffer PFR** to the tube. See Table 2 for optimal volume of Buffer PFR.

Add **10–50 µL Buffer PFN** to the tube. See Table 3 below for recommended volume of Buffer PFN.

Precool mortar and pestle with liquid nitrogen or at -70 °C.

Add **500 mg sample** to the mortar containing liquid nitrogen.

Grind sample in liquid nitrogen until a fine powder is obtained.

Transfer sample to the microcentrifuge tube containing the buffer mixture and mix immediately. The plant material shall only thaw within the lysis buffer.

Centrifuge for **1 min** at **14,000 x g** in order to sediment cell debris.

Note: If the cell debris pellet is not sufficiently solid, centrifuge for a longer time (e.g., 3 min) and/or at 20,000 x g.

Transfer the clear **supernatant** to a fresh tube (not provided).

Note: For acidic samples it is important to remove cell debris prior to heat incubation.

Incubate lysis tube for **5 min** at **56 °C**.



500 µL PFL
10–50 µL PFR
10–50 µL PFN

Mix



Grind sample



Transfer sample



14,000 x g,
1 min



Transfer supernatant

56 °C, 5 min

Option B: NucleoSpin® Bead Tubes Type G (not provided)

Add **500 µL Buffer PFL** into **NucleoSpin® Bead Tube Type G**.



500 µL PFL
10–50 µL PFR
10–50 µL PFN

Add **10–50 µL Buffer PFR** to the tube. See Table 2 for optimal volume of Buffer PFR.

Add **10–50 µL Buffer PFN** to the tube. For an appropriate amount see the Table 3.

Transfer **500 mg sample material** into the NucleoSpin® Bead Tube Type G.

Transfer sample

Place the Bead Tube into a swing-mill and **agitate twice** for **30 s** at 30 Hz with intermediate position change (please refer to the manufacturers' instructions for proper use of the machine).



Agitate
2 x 30 s

Remove steel balls from the NucleoSpin® Bead Tube Type G.



Attention: Removal of steel balls is necessary in order to avoid tube damage during subsequent centrifugation.

Centrifuge for **1 min** at **14,000 x g** in order to sediment cell debris.



14,000 x g,
1 min

Note: If the cell debris pellet is not sufficiently solid, centrifuge for a longer time (e.g. 3 min) and/or at 20,000 x g

Transfer the clear **supernatant** into a fresh tube (not provided).



Transfer supernatant

Note: For acidic samples it is important to remove the cell debris before heat incubation.

Incubate sample for **5 min** at **56 °C**.

56 °C, 5 min

Continue with protocol 5.1, step 2: "Filtrate lysate"

6 Appendix

6.1 Removal of DNA

In case samples with high initial DNA content are analyzed by downstream applications highly sensitive towards DNA contamination, an additional DNA digest might be required. Protocols for DNase treatments are given below.

Protocol A: DNA digestion in solution

1 Digest DNA (Reaction setup)

Add **6 µL Reaction Buffer for rDNase** and **0.6 µL rDNase** to **60 µL eluted RNA**.

(Alternatively premix 100 µL Reaction Buffer for rDNase and 10 µL rDNase and add 1/10 volume to one volume of RNA eluate). Gently swirl the tube in order to mix the solution. Spin down gently (approx. 1 s at 1,000 x g) to collect every droplet of the solution at the bottom of the tube.

2 Incubate sample

Incubate for **10 min** at **37 °C**.

3 Repurify RNA

Repurify RNA with a suitable RNA cleanup procedure, for example by use of the NucleoSpin® RNA Clean-up, NucleoSpin® RNA Clean-up XS kits (see ordering information), or by ethanol precipitation.

Ethanol precipitation, exemplary

Add **0.1 volume** of **3 M sodium acetate, pH 5.2** and **2.5 volumes** of **96–100 % ethanol** to **one volume of sample**. Mix thoroughly.

Incubate **several minutes** to **several hours** at **-20 °C** or **4 °C**.

Note: Choose long incubation times if the sample contains low RNA concentration.

Short incubation times are sufficient if the sample contains high RNA concentration.

Centrifuge for **10 min** at **maximum speed**.

Wash RNA pellet with 70 % ethanol.

Dry RNA pellet and resuspend RNA in RNase-free H₂O.

Protocol B: On-column DNA digestion

Reconstitution of rDNase

Add 4 mL Reaction Buffer for rDNase into a rDNase Vial Size F and dissolve the DNase.

On-column digestion into purification procedure

Follow the purification procedure according to section 5.1 until the column has been washed with 500 µL Buffer PFW1 (in step 5).

Apply **95 µL rDNase reaction mixture** directly onto the center of the silica membrane of the column.

Incubate at **room temperature** for **15 min**.

Continue the procedure 5.1, step 5, by adding 500 µL Buffer PFW2 onto the column.

6.2 Troubleshooting

Problem	Possible cause and suggestion
Clogged NucleoSpin® RNA Plant and Fungi Filter	<i>Too much sample material</i> Use less sample material and/or centrifuge for 3 min at 20,000 x g.
Poor RNA quality or yield	<i>Fruit tissue sample not cleared prior to heat incubation</i> - Clear fruit tissue sample lysates and perform the heat incubation with the clear supernatant only. <i>Sample with high starch content was heat incubated</i> - Samples such as potato tubers, maize kernels, wheat kernels and similar should not be incubated at elevated temperatures during the RNA purification procedure - However, banana fruit tissue of ripe fruits should be heat incubated in order to obtain high RNA yield.
Poor RNA purity and or colored silica membrane/ eluate	<i>Washing steps not sufficient</i> Perform an additional wash step with Buffer PFW2.

Problem	Possible cause and suggestion
	<i>RNase contamination</i> • Create an RNase-free working environment. Wear gloves during all steps of the procedure. Change gloves frequently. Use of sterile, disposable polypropylene tubes is recommended. Keep tubes closed whenever possible during the preparation. Glassware should be oven-baked for at least 2 hours at 250 °C before use. <i>Insufficient sample quality</i> • Control sample harvest, storage, and lysis. Make sure that samples are harvested, stored and lysed adequately in order to preserve RNA integrity. Whenever possible, use fresh material. If this is not possible, flash freeze the samples in liquid nitrogen. Samples should always be kept at -70 °C. Never allow tissues to thaw before addition of Lysis Buffer. Perform disruption of samples in liquid nitrogen.
Poor RNA quality or yield	<i>Insufficient sample disruption</i> • Choose a different disruption method. If one disruption method gives unsatisfactory results, try an alternative disruption method. <i>Reagents not applied or restored properly</i> • Prepare Buffer PFW2 by adding ethanol according to the description. • Sample and reagents have not been mixed completely. Always vortex vigorously after each reagent has been added. <i>Kit storage</i> • Store kit components at room temperature. Storage at low temperature may cause salt precipitation. • Keep bottles tightly closed in order to prevent evaporation or contamination

Problem	Possible cause and suggestion
Poor RNA quality or yield (continued)	<i>Ionic strength and pH influence A_{260} absorption as well as ratio A_{260}/A_{280}</i> - For adsorption measurement, use 5 mM Tris pH 8.5 as diluent. Please see also: - Manchester, K L. 1995. Value of A_{260} / A_{280} ratios for measurement of purity of nucleic acids. <i>Biotechniques</i> 19, 208–209. - Wilfinger, W W, Mackey, K and Chomczynski, P. 1997. Effect of pH and ionic strength on the spectrophotometric assessment of nucleic acid purity. <i>Biotechniques</i> 22, 474–481.
Low A_{260}/A_{230} ratio	<i>Carry-over of contaminants</i> - Carefully load the lysate to the NucleoSpin® RNA Plant and Fungi Column and try to avoid a contamination of the upper part of the column and the column lid. - Make sure that a sufficient amount / concentration of RNA is used for quantification so that the A_{230} value is significantly higher than the background level. - Measurement of low amount / concentration of RNA will cause unstable A_{260}/A_{230} ratio values.
Contamination of RNA with genomic DNA	<i>Too much cell material used</i> - Reduce quantity of sample material used. <i>DNA detection system too sensitive</i> - The amount of DNA contamination is reduced by the NucleoSpin® RNA Plant and Fungi Filter Column. However, dependent on the sample type and amount, it can not be guaranteed that the purified RNA is 100 % free of DNA. Therefore, in very sensitive applications, it might still be possible to detect DNA. The probability of DNA detection with PCR increases with: - the number of DNA copies per preparation: single copy target < plastidial / mitochondrial target < plasmid transfected into cells - decreasing of PCR amplicon size. - Use larger PCR targets (e.g., > 500 bp) or intron spanning primers if possible. - Use one of the support protocol, section 6.1, for subsequent DNA digestion in solution or on-column.

Problem	Possible cause and suggestion
Suboptimal performance of RNA in downstream experiments	<i>Carry-over of ethanol or salt</i>
	- Do not let the flowthrough touch the column outlet after the wash steps. Be sure to centrifuge at the corresponding speed for the respective time in order to remove last wash buffer completely. - Check if wash buffer has been equilibrated to room temperature before use. Washing at lower temperatures lowers efficiency of salt removal by wash buffer.
Damaged Bead Tubes Type G	<i>Store isolated RNA properly</i>
	Eluted RNA should always be kept on ice for optimal stability since trace contaminations of omnipresent RNases (general lab ware, fingerprints, dust) will degrade the isolated RNA. For short term storage freeze at -20 °C, for long term storage freeze at 70 °C.
	<i>Beads not removed from Bead Tube</i>
	Remove steel balls from the Bead Tube by placing a magnet on top of the lid. Invert the tube once. Open the tube and remove steel balls attached to the lid.

6.3 Ordering Information

Product	REF	Preps/Pack of
NucleoSpin® RNA Plant and Fungi	740120.10/.50	10/50
Lysis Buffer PFL	740122.30	30 mL
Reduction Buffer PFR	740123.5	5 mL
Neutralization Buffer PFN	740121.5	5 mL
Wash Buffer PFW2 (concentrate)	740124.12	12 mL
NucleoSpin® Bead Tubes Type G	740817.50	50
NucleoSpin® RNA Clean-up	740948.10/.50/.250	10/50/250
NucleoSpin® RNA Clean-up XS	740903.10/.50/.250	10/50/250
NucleoSpin® RNA/Protein	740933.10/.50/.250	10/50/250
NucleoSpin® TriPrep	740966.10/.50/.250	10/50/250
NucleoSpin® miRNA	740974.10/.50/.250	10/50/250
NucleoZOL	740404.200	200 mL
NucleoSpin® RNA Set for NucleoZOL	740406.10/.50	10/50
rDNase Set	740963	1
Collection Tubes (2 mL)	740600	1000

6.4 Product use restriction / warranty

NucleoSpin® RNA Plant and Fungi kit components were developed, designed and sold for research purposes only. They are suitable for in vitro uses only. No claim or representation is intended for its use to identify any specific organism or for clinical use (diagnostic, prognostic, therapeutic, or blood banking).

It is rather the responsibility of the user to verify the use of the NucleoSpin® RNA Plant and Fungi kits for a specific application range as the performance characteristic of this kit has not been verified to a specific organism.

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