Maskiner og planteavl | no. 100 | 2009

FarmTest

Equipment for internal rinsing of sprayers

Title: Equipment for internal rinsing of sprayers - Three systems for subsequent installation
Authors: Niels Enggaard Klausen, AgroTech, Jens Johnsen Høy, AgroTech, and Per Gummer Andersen, Betterspraying ApS
Review: Hans Henrik Pedersen, AgroTech
Layout: Gitte Bomholt, AgroTech
Print: Danish Agricultural Advisory Service
Edition: 1. edition February 2009
Issue: 15 unit
Publisher: Danish Agricultural Advisory Service
National Centre
Udkaersvej 15, Skejby
DK-8200 Århus N
Phone +45 8740 5000 • Fax 8740 5010
E-mail farmtest@landscentret.dk
www.farmtest.dk
ISSN 1601-6777

Equipment for internal rinsing of sprayers

- Three systems for subsequent installation

Written by Niels Enggaard Klausen, AgroTech, Jens Johnsen Høy, AgroTech, and Per Gummer Andersen, Betterspraying.

AgroTech

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PREFACE

AgroTech would like to thank;

Hardi Skandinavien
Helgeshøj Allé 38
DK-2630 Taastrup
www.hardi.dk

Skærbæk Maskinforretning
Åbenråvej 17
DK-6780 Skærbæk
Phone: +45 7475 1205

Kyndestoft Maskinfabrik
Ll. Hedegårdvej 2
DK-7500 Holstebro
Phone +45 9613 3000

for putting the rinse equipment at our disposal.

1. SUMMARY

It is possible to dilute the remnant residue in the bottom (the sump) of the sprayer down to 1 % of the original tank concentration with all the tested rinse equipments.

The three tested systems are seen on the photos below:

Hardi

Aams (Skærbæk Maskinforretning)

Kyndestoft

The systems from aams and Kyndestoft uses a 12 volts pump for continuously leading the rinse water from a mounted rinse tank to the main tank and the hoses. The system from Hardi uses the pump on the sprayer. Here the rinse water is divided in three parts and a triple rinse is carried out.

When using both methods for rinsing, all valves have to be activated during rinsing to make sure the whole liquid system is rinsed properly.

The rinse water must be discharged in the treated area, driving forward and spraying at the same time. Do not excide maximum dosage.

The two systems for continuously rinsing are the quickest method to dilute the remnant residue till less than 2 %, also operating the equipment and the valves are more comfortable as it can be done from the tractor.

2. INTRODUCTION

Background

According to Pesticide Plan 2004-2009 by the Danish government, rules of filling and cleaning of spray equipment must be more accurate in order to reduce the risk of point source pollution. Point source pollution can occur where spray equipment are washed after use or where pesticides are filled in the sprayer.

The Government regulation concerning Wash and Filling of Sprayers used for Plant Production Products, are about to be published in the nearest future. The objective is to reduce pollution of soil, ground and surface water as a result of filling and washing sprayers.

Demands are made on where sprayers are washed and pesticides are filled, as well as requirements are made on the equipment such as induction hopper, rinse tank and inside cleaning nozzle. The rinse tank must have a capacity to dilute the remnant residue 50 times.

This FarmTest concentrates exclusively on equipment for rinsing to ensure the remnant residue can be diluted fifty times which is down to 2 % of the original tank concentration. Equipment for rinsing can be mounted on most sprayers, which do not already have a rinse tank. To nurseries, gardeners and farmers it is important to know the effect of rinsing equipment, which can be mounted on older sprayers. With a rinse tank and inside cleaning nozzle, it is possible to dilute and spray the remnant residue on the treated area.

Words like *rinsing; cleaning and washing* are often confused. In this FarmTest we distinguish between the terms.

Inside rinsing means that the inside of the main tank is flushed with clean water until the remnant residue is diluted minimum 50 times. Rinsing will, if nothing else is mentioned at the label, be sufficient after ended spraying and if next spraying is in a similar crop.

Inside cleaning are often done with a cleaning agent, and is done if the next spray job is in a sensitive crop and if it is prescribed on the label or before maintenance check and winter-preparation.

Washing is here used as a less precise, generic term for rinsing and cleaning.

Objective
The objective of the FarmTest is:

- To gain insight into available equipment for diluting and inside rinsing of sprayers that easily can be mounted on sprayers.
- To investigate if it is possible to dilute the remnant residue down to 2 % of original tank concentration as demanded in the government regulation.
- To focus on the requirement of using rinsing equipment.

3. MATERIALS AND METHODS

Materials

The following three products for inside rinsing of the main tank were tested in the FarmTest. The systems comprise rinse tank and inside cleaning nozzle:

Hardi Rinsing Tank

- 120 litre rinse tank with inside cleaning nozzle. The rinse water is sucked by the sprayer pump
- Mounted on a Hardi LX 800 with a 12 meter boom

aams Quick Clean Kit

- 55 litre rinse tank with 12 volt pump (9 l/min), inside cleaning nozzle and lance to external rinsing.
- Mounted on a Hardi LX 1000 with a 12 meter boom

Kyndestoft Rinsing Tank

- 70 litre rinse tank with 12 volt pump (13 l/min) and inside cleaning nozzle.
- Mounted on a Hardi LXY 800 with a 12 meter boom

All equipment was tested on older Hardi sprayers, sprayers that there is several thousands of in Denmark.

Methods

Two different methods were used rinsing the inside of the sprayers. The two methods are explained below.

A. Continuously rinsing
This method requires an extra pump besides the sprayer pump. The output of the extra pump must be at least 50 % of the total nozzle output on the whole boom. The return to the tank during the rinsing must be maximum 2 l/min.

Turn off the agitation when the tank is almost empty, and spray until air comes out of the nozzles.

Turn on the pump for the rinse tank and lead the rinse water in the main tank through the rinse nozzle. Spray out the rinse water through the nozzles, while clean water continuously is lead in through the rinse nozzle. The remnant residue is continuously diluted and replaced. To flush all hoses and valves with more and more clean water, all valves have to be activated 3-5 seconds at the time. Do this three times through the process.

Operating the pump and valves can be done from the tractor when driving in the treated area.

B. Triple rinsing
The sprayers' own pump is used.

Turn off the agitation when the tank is almost empty and spray until air comes out of the nozzles.

1/3 of the rinse water is lead to the main tank. Turn on agitation and activate all valves to flush all hoses. Rinse the main tank via the inside cleaning nozzle.

Spray out the rinse water through the nozzles while driving in the treated area until air comes out of the nozzles

Repeat this procedure twice until the rinse water is used.

Electrical motors can be mounted on the valves and can then be operated from the tractor. Otherwise loading rinse water and operating the valves should be done standing on the ground.

The equipment decides the method

Triple rinsing is recommended when the pump on the sprayer is used. The rinse water is divided in three parts and rinsing and diluting is done at three rounds; this results in a higher degree of dilution as opposed to if all water is used at once. This method has been recommended for rinsing and cleaning for a long time.

In the joint European TOPPS project finished in 2008 with the objective to prevent point source pollution, the method of continuously rinsing was tested. This method is recommended when an extra pump is used.

The equipment from aams and Kyndestoft are delivered with a 12 volt pump, therefore continuously rinsing is done with this equipment. The equipment from Hardi use the sprayers' own pump, here a triple rinsing is done.

Measuring the cleanness of the rinse water

Clean water and a tracer were filled in the main tank. To ensure the tracer contaminated the entire liquid system, all valves were activated while the main tank was emptied by normal spraying. To be able to follow the dilution compared to the original tank concentration, samples of the spray liquid were taken every half minute.

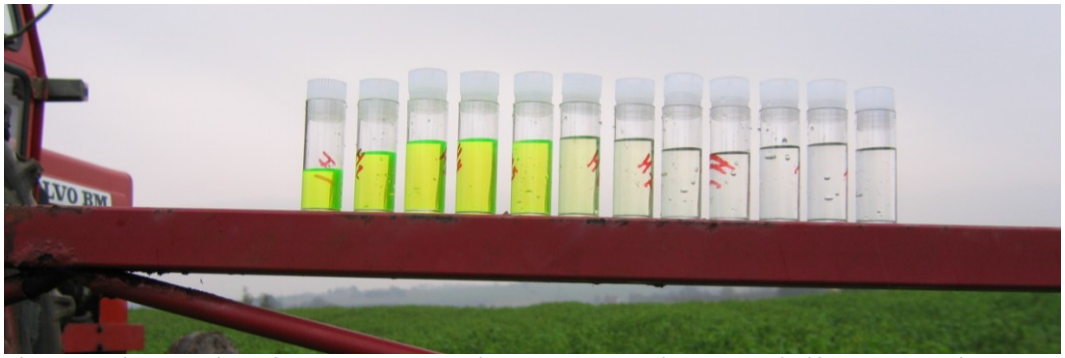

Photo 1. The samples of rinsing water with tracer were taken every half minute at the outermost nozzle.

Photo 2. Samples with tracer are ready for analysis in the fluorimeter. The exact amount of tracer can be measured.

The tracer Sodium Fluorescein emits light (fluoresce) when energy is supplied, this fluoresces can be measured by a fluorimeter. The exact amount of tracer in every sample can thereby be measured, and thus how much the rinsing water is diluted compared to the original tank concentration. Tank concentration was set at 100 %.

After rinsing the inside of the tank, using one of the methods, samples were taken of the liquid hidden in hoses and valves. In the hoses and valves there is a risk of higher concentration than in the remnant residue in the main tank.

The hoses and valves selected for sampling were the valve for pressure agitation, the valve with even pressure device, the pressure filter and the self-cleaning filter. Concentration and volume of the remnant residue in the sump were also measured.

With each type of equipment three repetitions were made.

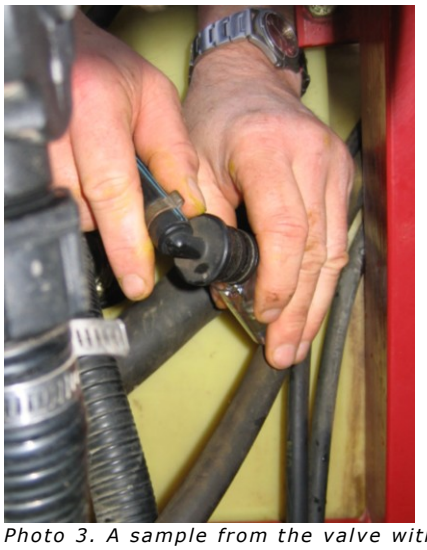

Photo 3. A sample from the valve with even pressure device is taken.

4. RESULTATER

All three systems managed to dilute the residual remnant down under 2 % as prescribed in the government regulation. After rinsing and diluting, all three systems managed to dilute the residual remnant down less than 1 % of original tank concentration.

Concentration in hoses and valves
After the triple rinsing with the equipment from Hardi, the concentration of tracer in all the screened hoses and filters was found to be less than 1 %

A concentration of tracer above 2 % was found in some hoses and filters after rinsing using both the system from aams and Kyndestoft.

Consumption of time
Continuously rinsing is the quickest method. The two tested equipments for continuously rinsing both managed to dilute the residual remnant down less than 1 % in less than six minutes.

Triple rinsing took approximately eleven minutes, all in all operating the valves and spraying while driving forward.

Progress of diluting
The following three figures show how the remnant residue in the sump gradually is diluted, testing each equipment. Concentration was measured every half minute at the outermost nozzle. The degree of dilution was compared to the original tank concentration set at 100 %. The graphs show an average of the three repetitions. The variation between the repetitions was very little.

Results - Hardi

A triple rinsing was done with a total 100 litre rinsing water. At each red arrow on the graph, one third of rinsing water was added. All valves were activated and the inside of the main tank was flushed using the inside rinsing nozzle. Afterwards the rinse water was sprayed out through the nozzles, while driving forward.

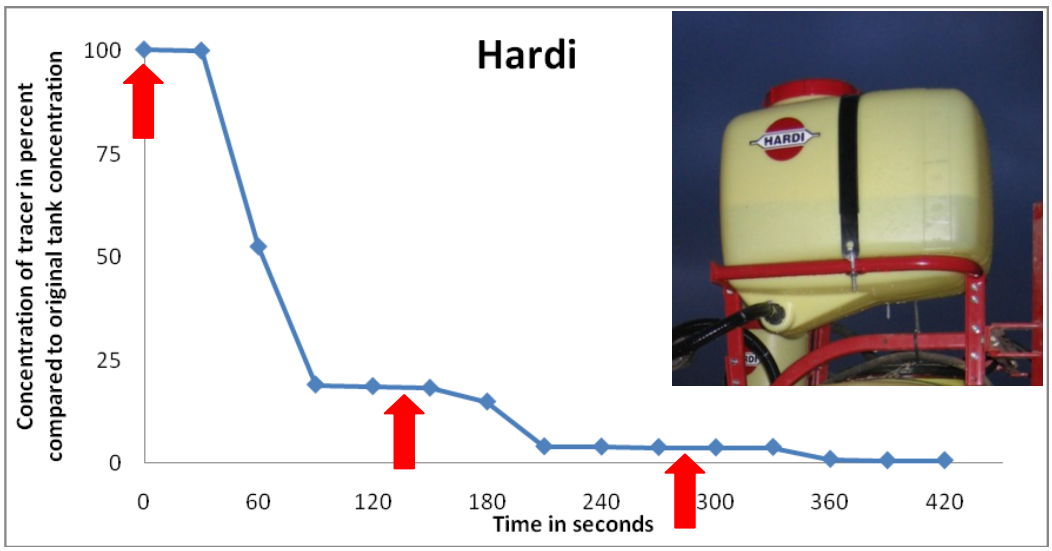

Figure 1 – Hardi - Concentration of tracer measured at the outermost nozzle during rinsing using the equipment from Hardi. The graph shows an average of three repetitions. At the red arrows one third of rinsing water was added, used for diluting the remnant residue, the rinse water was then sprayed out.

After first round of rinsing the concentration was reduced from 100 % to 18 %, after the second round down to 4 % and after the last round of rinsing the concentration was 0.7 % in average. In each repetition the concentration was less than 1 %.

After 6 minutes of rinsing the concentration was less than 2 %.

After 6½ minutes of rinsing the concentration was less than 1 %.

All in all the rinsing procedure took approximately 11 minutes, including the three rounds of operating the valves and emptying the sprayer while driving forward.

After ended procedure the concentration of tracer in all hoses and filters was less than 1 %.

The volume of the sump was measured when no more liquid came out of the nozzles. In this sprayer (LX 800) the volume was between 1.0 and 1.4 litres. The average was 1.2 litres.

Results - aams

A continuously rinsing was done with this equipment, using 55 litres of rinsing water. The output of the 12 volt pump was 9 litre pr. minute. The pump was started and all valves were activated three times during the rinsing procedure. The tractor drove while rinsing.

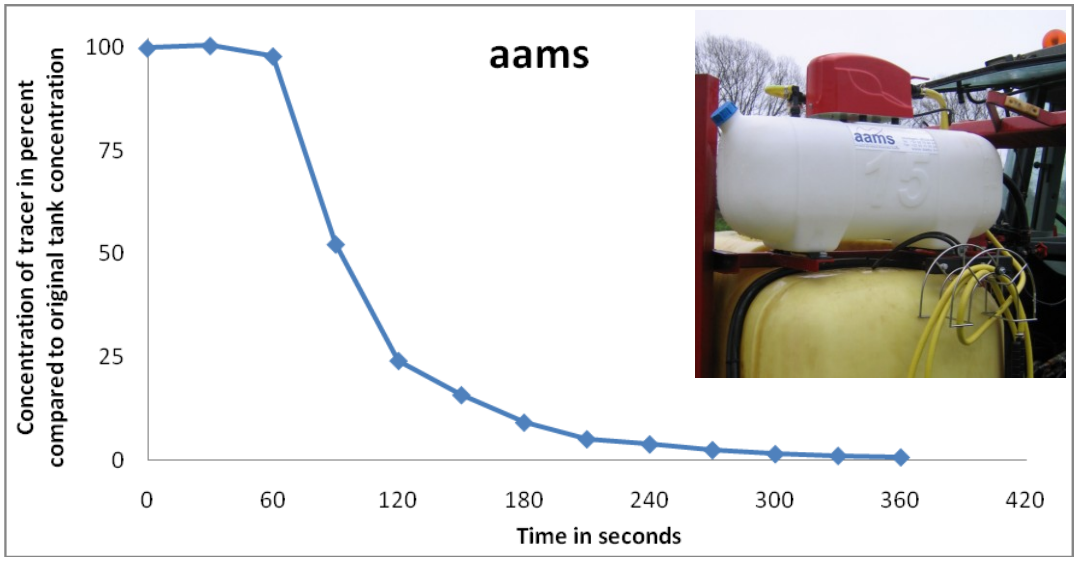

Figure 2 – aams - Concentration of tracer measured at the outermost nozzle during rinsing using the equipment from aams. The graph shows an average of three repetitions. The rinse water was continuously added to the remnant residue while spraying.

The concentration was close to 100 % during the first minute, afterwards the concentration decreased gradually. In each repetition the concentration was less than 1 %.

After 5 minutes of rinsing the concentration was less than 2 %.

After 5½ minutes of rinsing the concentration was less than 1 %.

After one of the repetitions the concentration of the liquid in the hoses to both the valve for pressure agitation and the valve with even pressure device was over 2 %. In the other two repetitions the concentration was less than 1 %.

The volume of the sump was measured until no more liquid came out of the nozzles. In this sprayer (LX 1000) the volume was between 2.0 and 2.8 litres. The average was 2.5 litres.

Results - Kyndestoft

A continuously rinsing was done with 70 litres in the rinse tank, only 55 litres was used. The output of the 12 volt pump was 13 litre pr. minute. The pump was started and all valves were activated three times during the rinsing procedure. The tractor drove while rinsing.

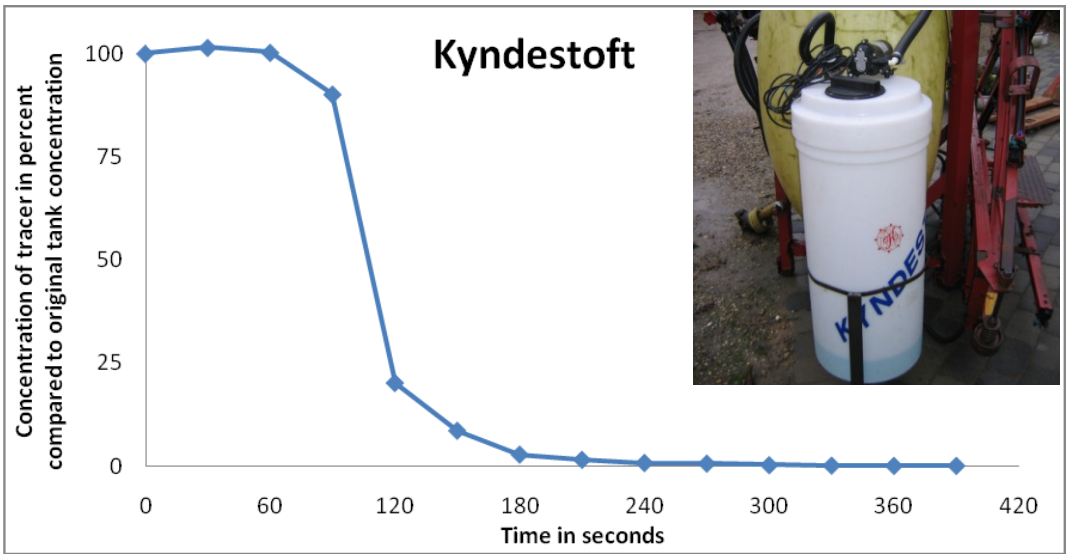

Figure 3 – Kyndestoft - Concentration of tracer measured at the outermost nozzle during rinsing using the equipment from Kyndestoft. The graph shows an average of three repetitions. The rinse water was continuously added to the remnant residue while spraying.

After approximately 1½ minutes the concentration rapidly was reduced. In each repetition the concentration was less than 1 %.

After 3½ minutes of rinsing the concentration was less than 2 %.

After 4 minutes of rinsing the concentration was less than 1 %.

In the hose for the valve with even pressure device the concentration was less than 1 %. In the pressure filter the concentration was 2.3 %.

The volume of the sump was measured when no more liquid came out of the nozzles. In this sprayer (LXY 800) the volume was between 1.0 and1.7 litres. The average was 1.4 litres.

5. DISCUSSION

All three systems managed to dilute the remnant residual till less than 2 % as described in the government regulation.

When using continuously rinsing, concentrations of tracer above 2 % were found in hoses and filters. This is of no importance according to fulfil the requirements in the government regulation, as the liquid in these hoses and filters will be attenuated when the main tank is filled at the next spray job. In addition to this only approximately 45 litres of rinse water were used to reach 2 %, which leaves 10 and 35 litres of rinse water in the rinse tank from respectively aams and Kyndestoft. Using this extra amount of rinse water for rinsing hoses and filters, the concentration properly would be less than 2 %.

No hoses and filters exceeded 1 % using the equipment from Hardi.

To avoid high concentrations to be retained in the hose for the safety valve, a 1 mm hole can be drilled as seen next to the arrow on photo 4. This secures a continuous flow in the hose, but the back flow has no impact on the degree of dilution.

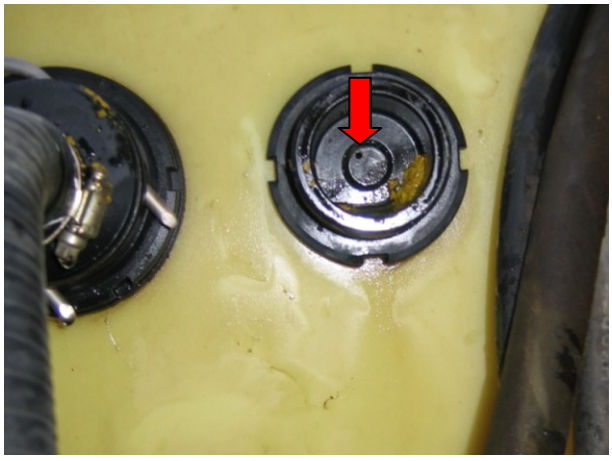

Photo 1. By drilling a 1 mm hole, the hose for the safety valve can continuously be flushed, preventing high concentrations.

Operating the systems

The two systems using 12 volts pumps are very easy to operate, as the operator doesn't have to leave the tractor three times. Operating the pump and the valves can be done while the tractor is driving.

Hardi Scandinavia agrees that is much easier to do a continuously rinsing instead of a triple rinsing. For those sprayers which do not already have a rinse tank mounted, Hardi now introduces a kit with rinse tank and a 12 volt pump for subsequent installation.

Focus on the requirement of using rinsing equipment
One of the objectives in this FarmTest is to focus on the requirements of using rinsing equipment. The FarmTest shows that these requirements can be accommodated by relatively small investments.

The type of equipment you choose may depend on the type of sprayer, it should be mounted on. It is important that the rinse tank is well-placed in order not to block the view from the tractor. It should not be in the way when driving, and it must also be easy to fill in clean water.

External rinsing
The test has only focused on internal rinsing of the main tank. The equipment from aams is delivered with a lance for external rinsing. Hardi and Kyndestoft also provide hose and lance making external rinsing possible.