Evaluation of the use of sulphur for scab control in organic fruit production: A literature survey

Evaluation des Schwefeleinsatzes im biologischen Obstbau

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Introduction

Until now organic fruit production is using sulphur for scab control because it is a relatively harmless pesticide. Apple and pear scab are such persistent pests that management by cultivation procedures cannot offer sufficient protection. With the presently available cultivars it is not possible to work without fungicides.
Organic fruit growers do not really feel happy with the use of sulphur. Information services do not know the answers to several questions on how to reduce side effects and improve effectiveness.

Report

These questions were the reason for a literature survey which was performed in 1992. The report of this survey will be published by the Nationale Raad voor Landbouwkundig Onderzoek in spring 1993; the report will be in Dutch with an English summary. Its table of contents printed below shows the subjects dealt with. Some conclusions of the report follow.

Some conclusions

1. Origin

Formerly sulphur was mined. At present it is a residual product of the removal of sulphur from mineral oil. Wettable sulphur contains 80 % of sulphur and further stone dust and synthetic adhesive and wetting agents.

2. Toxicology

Sulphur hardly causes toxicity problems to the producer, the user or the environment. Some fruitgrowers noticed irritations while spraying without mask. Sulphur is easily incorporated into natural cycles. These are important advantages in comparison to synthetic fungicides.

3. Soil acidification

In the long run sulphur contributes to the acidification of the soil. Application of lime equivalent to 1,4 kg CaO per 1 kg wettable sulphur is required to compensate for the acidifying effect.

4. Beneficial insects

All species of beneficial insects occuring in orchards not treated with sulphur also occur in treated orchards. There are occasional statements that sulphur is harmful to predatory mites. An amount of 5 kg/ha or less is usual for applications after bloom. This amount spares predatory mites.
It is true that after application of sulphur the number of predatory mites is reduced. However, this may be explained by the reduction of the population of red spider mites. One can imagine that in the long run predatory mites become less sensitive to sulphur. However,this has never been demonstrated. Under laboratory conditions some species of parasitic wasps are sensitive to sulphur. Under field conditions they are little sensitive to it.

5. Phytotoxicology

An obvious disadvantage of sulphur is the danger of a rough skin of the fruits, sunburn and possibly hampered growth. There has been remarkably little research on these defects. Roughness and sunburn strongly depend on the weather. The risk of these defects is less, if the supply of water to the tree is regular. There must always be sufficient "turgor" in the cells. In practice an addition of stone dust (bentonite, kaoline or ULMASUD) to the sulphur spray during a month after bloom proved to be a good remedy against roughness. It is occasionally stated that sulphur is harmful to growth, quality of buds and yield. However, this has never been investigated. Some varieties are sensitive to sulphur. Yield is reduced and fruit fall in June is more extensive. Examples are 'Cox's O.' and 'Berlepsch'. For application to these varieties the concentration of sulphur must be reduced.

6. Effects on other diseases and pests

Application of sulphur for scab control has also effects on mildew, apple rust mite, fly speck and sooty blotch. A possible development of varieties that are resistant to scab would make the use of sulphur unnecessary. Then these diseases may become a problem, however a minor problem compared with scab.

7. Resistance

The risk of the scab mould becoming resistant to sulphur is very small.

8. Effectiveness

Sulphur is less effective than CAPTAN and certainly less effective than application programmes including, among others, curative fungicides. The use of only preventive pesticides requires great professional skill.

9. Reduction of the quantity of sulphur applied

In The Netherlands between 20 and 100 kg wettable sulphur is used per hectare and year. The quantity applied strongly depends on the weather, the amount of infections from the preceding year, the variety and the grower's experience. The quantity applied could be

reduced by an application of copper or MYCOSAN before bloom, more effective cultivation procedures, application of an agent to strengthen plants, an application programme that is adapted to the variety grown in the orchard and possibly by the admixture of other materials. For the use of strengthening agents more research would be necessary.

10. Other sulphur formulations

There is insufficient experimental evidence on the advantages and disadvantages of the various types of sulphur and on the advantages of all admixtures. In most cases additions do not improve the effectiveness of sulphur applications. Insufficient research has been done on the possible reduction of side effects of sulphur by additions. In table 1 (see below) a lack of knowledge is indicated by an interrogation mark. One can imagine that the addition of stone dust makes the action of sulphur weaker though more persistent. In an extensive application programme, this would be an advantage, but in an intensive programme a disadvantage. On the dutch market stone dust residues on fruits are not accepted.

11. Costs

Wettable sulphur is a very cheap fungicide.

12. Alternatives

There are no promising alternatives rapidly available that meet the requirements of organic agriculture.

13. Questions to be investigated

Liquid sulphur: Which are the advantages and disadvantages in comparison with wettable sulphur?
MYCOSAN: It is expensive. What are the concenquences of such a low pH? It is only promising for application before bloom as a substitute for copper + sulphur.
Lime sulphur: This might be useful as a substitute for copper and/or a curative pesticide. Therefore it is important to know its phytotoxicity in comparison with copper if applied before bloom.
Ivy extract: It has to be tested in a good test formulation under field conditions.
***Equisetum* tea**: Does it reduce storage scab and late, little aggressive moulds when applied in August and September?
Water-glass and/or Preicobact: Do those products seal hibernating conidiospores if applied in March?

Questions for discussion in Weinsberg:

1. To which extent are the above conclusions in accordance with your experience?
2. To which extent is the above information new?
3. Have important aspects been omitted?
4. What are the priorities for further investigation?

Annexes

Table 1: Experience with various types of sulphur and with mixtures in comparison with wettable sulphur with regard to:

EFF Effectiveness as protection against scab
QUA Quantity of sulphur per unit area required for the same degree of scab control
PHY Phytotoxicity to leaves or flowers
ROU Roughness of fruit skin
NAT Natural enemies
DUS Dusty residues on the fruit
PRI Price

	EFF	QUA	PHY	ROU	NAT	DUS	PRI
Liquid sulphur	= ?	≤ ?	?	> ?	≤ ?	≤ ?	>
Lime sulphur	>	= ?	>	>	>	>	?
Hepar Sulfuris	= ?	?	≥ ?	≥ ?	≥ ?	<	>
Wettable sulphur +soap	= ?	≤ ?	?	<	?	=	≥
Wettable sulphur + chalk	=	=	≤ ?	≤ ?	?	>	>
W.S + stone dust or bentonite	= ?	≤ ?	≤ ?	<	?	>	>
NAB	= ?	≤ ?	< ?	< ?	≤ ?	>	>
Bio-S/Biosan	< ?	= ?	< ?	< ?	≤ ?	>	>>
Wett.S. + waterglass[1]	≥	= ?	≥ ?	?	?		≥
Wett.S.+ Ulmasud	≥	<	?	<	= ?	>	>>
Mycosan	≥	≥	?	<	= ?	>	>>
Wett. S. + copper[1]	>	<	>	>	= ?		= ?

1 = before bloom only

< smaller than
≤ smaller than or equal to
> larger than
≥ larger than or equal to
= equal to
>> much larger than