PRELIMINARY TESTS ON QUALITY OF HIGH MOISTURE DATES WITH FIVE ALTERNATIVES TO METHYL BROMIDE

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The Parties of the Montreal Protocol have discussed the problem of the disinfestation of fresh high moisture content Deglet-Nour dates without methyl bromide in Algeria and Tunisia. In 2003, MBTOC noted that technically and economically effective alternatives have not been found to resolve the problem of pests in these particular dates. That's why the Parties indicated with the Decision XV/12 a need for a project to find an alternative which can replace methyl bromide.
In 2008, UNIDO responded to this Decision in designing preliminary tests which were carried out in Bordeaux (LNDS: Stored Products National Laboratory). The project MP/RAB/08/002, financed by the Executive Committee of the Multilateral Fund, is entitled "Regional demonstration project on alternatives to the use of methyl bromide for treatment of high moisture dates (Algeria and Tunisia). This study was carried out on five potential alternatives to MeBr. The main target of this study was to observe the impact of each treatment on the quality of dates. The quality was defined before and after treatment by the colour of dates, the smelland the taste. The efficacy was observed only on the natural infestation.
The main problem of these Deglet-Nour dates is their high moisture content which is between 30 and 40% (w/w). As a result, the exposure time of fumigation must be very quick to reduce the risk of fermentation during the treatment. Moreover, the colour of dates is very light and sometimes seems to be as honey, and the treatments must respect this uniqueness. The main pest which infests dates in Algeria and Tunisia before and after the harvest is a Lepidoptera: the carob Moth (*Apomyelois ceratoniae* (= *Ectomyelois ceratoniae*)).
A workshop was organized in Vienna April 16-17, 2009 where scientific and technical experts have discussed the results of these trials in order to keep the bests alternatives which will be tested in full scale at the end of 2009 in Biskra, Algeria.

Material and methods

One hundred kilograms of dates came from Algeria from SUDACO Company and for each modality 2.5, 5 or 10 kilograms of dates were used for the treated sample and the control sample. The colour of dates was defined with the Munsell® chart of color. The mortality rate of larvae or pupae was calculated after opening the dates. The temperatures and relative humidity measured during the treatments were taken with Captsystemes® data loggers.
Five alternatives in nine modalities were tested and a fumigation with MeBr was carried out as a reference.

1- Controlled atmosphere with 99% of nitrogen, 7 days, in 1 cubic-meter chamber
2- Phosphine with ammonia, 48 and 72 hours, 1 g/m^3, in 120 litres drums
3- Phosphine without ammonia, 48 and 72 hours, 1 g/m^3, in 11 litres chambers.
4- Phosphine + CO_2, 24 and 48 hours, in 1 cubic-meter chamber.
5- Sulfuryl fluoride under vacuum, 6 hours, 150 g/m^3, in 100 litres chamber.
6- Heat treatment, 50 or 53°C, 2, 3 or 6 hours in oven.
7- Ethyl formate, 6 hours, 70 g/m^3 in 11 litres chamber.
8- Ethyl formate under vacuum, 6 hours, 100 g/m^3, in 100 litres chamber.
9- Ethyle formate + CO_2, 6 hours, EF : 70 g/m^3 and CO_2 : 350 g/m^3, in 11 litres chamber.
10- Methyl bromide under vacuum (reference), 2 hours, 80 g/m^3, in 100 litres chamber.

Results and discussion

The controlled atmosphere with an exposure time of 7 days and an average temperature of 12.5°C is not a good alternative because the dates have fermented (Table 1). This treatment is too long and affects the quality and the conservation of these specific dates. Moreover, this kind of treatment requires an exposure time longer than 7 days, so this alternative can't be used for the disinfestation of high moisture dates.

The phosphine fumigations with an exposure time of 72 hours, and an average temperature between 17 to 19°C, shows interesting results. The dates fumigated with phosphine without ammonia present just a slight odour of fermentation but certainly due to a lack of O_2 during the treatment in the little fumigation chamber. On the other hand, the phosphine with ammonia fumigations make darker the dates. Moreover, the efficacy on insect's eggs, with an exposure time of 72 hours, is certainly not complete if the average temperature is below 25°C.

The mixture phosphine + CO_2 (EcoFume®) is may be better but there is another problem, the mixture is not avaible in Algeria and it is complicated to use these two gas without a mixture "ready to use".

Sulfuryl fluoride seems to be a very good alternative and doesn't affect the quality of dates at 15°C, moreover this gas could be used with the vacuum chambers which are already working in Algeria for the methyl bromide fumigations. But, sulfuryl fluoride is not registered for the disinfestation of dates in North Africa.

Heat treatments have shown very good results, the dates resist to these high temperatures, but we can observe the date skin a little bit drier. That's why this treatment requires a better investigation in order to study better the quality of dates after treatment and the efficacy of this technical on all insect's stages.

Ethyl formate seems to be promising under vacuum fumigation or with CO_2, but it is not currently registered in Algeria.

The insecticide efficacy was just observed with few larvae and few pupae, the infestation rate was very low and it is difficult to conclude to a good insecticide treatment or not. That's why the results are just trends and not significant.

Conclusion

- The main target of this study was to test five alternatives to methyl bromide on the quality (colour, smell and taste) of high moisture content fresh Deglet-Nour dates

  The controlled atmosphere is not compatible with the disinfestation of these dates because the exposure time is so long that the dates ferment and become inedible. The phosphine with ammonia fumigations make darker the dates and reduce the quality of the fruit.

  All other alternatives have potential to replace methyl bromide. Nevertheless, sulfuryl fluoride can not be considered for the next tests in full scale because there is not registration for dates in Algeria. The same for ethyl formate.

  That was the result of the UNIDO Vienna workshop: just two alternatives were kept to test in full scale:

  Phosphine without ammonia, with an exposure time of 3 days and high temperatures

  Heat treatment.

  It will be necessary to assess the efficacy of these two accepted alternatives on the most tolerant stage of Lepidoptera: the eggs.

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Table 1 : Influence of some alternatives to methyl bromide on the date quality: colour, smell, taste and on efficacy against larvae and pupae of Carob moth.

	Treatment	Colour	Smell	Taste	Efficacy against insects	Good alternative ?
1	Controlled atmosphere	N	F	F	A	No
2	Phosphine with ammonia, 48 h	Da	N	N	De	Yes and No
	Phosphine with ammonia, 72 h	Da	F	N	De	Yes and No
3	Phosphine without ammonia, 48 h	N	F[1]	N	De	Yes
	Phosphine without ammonia, 72 h	N	F[1]	N	De	Yes
4	Phosphine + CO_2, 48h	N	F[1]	N	De	Yes
5	Sulfuryl fluoride under vacuum, 6 h, 150 g/m^3	N	N	N	De	Yes
6	Heat : 53°C, 6 h	N[2]	N	N	De	Yes and No
	Heat : 50°C, 2 h	N[2]	N	N	De	Yes and No
	Heat : 50°C, 3 h	N[2]	N	Do	De	Yes and No
7	Ethyl formate, 6 h, 70 g/m^3	N	N	N	A	No
8	Ethyl formate under vacuum, 6 h, 100 g/m^3	N	N	N	De	Yes
9	Ethyl formate + CO_2, 6 h, 70 g/m^3 (EF)	N	N	N	De	Yes
10	Methyl bromide under vacuum, 2 h, 80 g/m^3	N	N	N	De	Yes

1: due to a lack of O_2
2: except dried skin
N: normal
F: fermented
Da: darker than control
A: Alive (one insect at least)
Do: doughy dates
De: Dead (100% mortality)