SEMARNAT/UNIDO DEMONSTRATIONS ON MB ALTERNATIVES FOR STRAWBERRY IN BAJA CALIFORNIA (MEXICO). PRELIMINARY RESULTS.

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Mexico is an important country in the cultivation of strawberries. It has a production close to 200,000 tons per year over 5500 cropped hectares. The most important growing areas are the States of Baja California, Michoacan and Guanajuato. In Baja California, strawberries are located in San Quintin Valley (33-34 ºN), along the Pacific Ocean coast, Southern Ensenada. In this area there are around 1000 hectares of strawberries, cropped outdoor in intensive systems highly influenced by the Californian technology. Annual yield is estimated at 60.000-70.000 tonnes per year for consumption and industry. Most of this production is exported to the United States. At present, a very high percentage of the cultivated area is treated annually with the mixture 75:25 MB:chloropicrin during August and September. The typical doses are 350 lb/ac (392 kg/ha) of the fumigant mixture.

The Mexican Government, through the Secretary of Environment and Natural Resources (SEMARNAT), in cooperation with the United Nations Industrial Development Organization (UNIDO), spent years assisting the agricultural sectors involved in the use of MB on a gradual reduction of the fumigant. This Pilot Project about demonstrations of alternatives to the MB in some key crops was launched for strawberries in summer 2007. Now the results in the first cropping season (2007-2008) are presented. Some chemical alternatives were tested in three farms in the San Quintin Valley: “Campo Olmos” (Berrymex), Campo José de la Luz “Rancho Don Juanito” and Campo Chichi “Santa Mónica”, located in three different towns along the coast (North to South): Colonia Ejido Emiliano Zapata, Colonia Vicente Guerrero and San Quintin, respectively. Planting dates are from September to October for fresh plant of short day cultivars. Harvesting begins from November to January and finishes during June. Varieties such as ‘Splendor’, ‘Festival’, ‘Camino Real’,’Albion’, and some Driscoll cultivars are very usual nowadays.

The Pilot Project started with chemical alternatives to MB that met the following requirements: a) they were technically and economically feasible in previous experimental works performed in Mexico, as well as in other major countries in the cultivation of strawberries, b) technical and logistical availability in the country and c) they have been already registered/authorised

in Mexico. Indeed, the companies owners of the rights for Mexico provided the products for free and were responsible of the application in these demonstrations (Table 1).

INSTALLATION OF DEMONSTRATIONS AND CROPS

"Rancho Don Juanito" (Colonia Vicente Guerrero): Activities for implementing the alternatives to MB were made during the first week of September 2007. Each demonstration (T1 to T5) tooks 17 beds of 70 metres long with 64 inches of spacing between centres of beds (4 rows of plants) with a plant density of around 56,000 plants/ha (Table 1). The planting date of the variety 'Splendor' (Berry Genetics) was on October 15, 2007.

"Campo Olmos" (Berrymex) (Colonia Ejido Emiliano Zapata): This field was not cropped before. Previously this area was covered with the native flora of the region. The implementation of the alternatives to MB took place during October 2007. In this case, Methyl iodide:chloropicrin (Midas®), was applied as demonstration T5. Each demonstration took between 12 and 16 beds of 81.89 m length and 68 inches of spacing between centres of beds (4 rows of plants) with a plant density of around 75,833 plants/ha (Table 1). The planting date of the variety 'Driscoll Agoura' was on October 26, 2007.

Campo Chichi "Santa Mónica" (Colonia San Quintín): The implementation of the alternatives to MB was during the second half of September 2007. In this case, overall standard (T0) was Piclor 35 EC® (InLine) (1,3-dichloropropene: chloropicrin), following the broadcast shank-application of MB:pic 75:25 of summer 2006. The same 5 demonstrations described for the 'Don Juanito' Farm were settled down (Table 1). Each demonstration took between 12 and 14 beds of 91 m length with 64 inches of spacing between centres of beds (4 rows of plants) at a plant density of around 56,000 plants/ha. The planting date of the variety 'Splendor' (Berry Genetics) was on October 21, 2007.

DEMONSTRATIONS DEVELOPMENT. RECORDED TRAITS

Major differences between treatments (T1-T5) in demonstrations and the overall standard (T0) were not found.

Replanting percentage: It shows the number of dead plants observed in each of the 5 studied beds in every demonstration and Farm. These plants were replaced by new viable plants (replant) a few weeks after the transplant. This parameter is an indirect measure of the soil health status before planting and the environmental conditions of the autumn in the area. It was noted the number of plants replanted/bed was very small. Replanting percentages were very low: always smaller than 2% (plants initially planted), with no significant differences ($P \leq 0.05$) among treatments (Table 2).

Weed control: It was carried out several times at the beginning of the season. The the total number of removed weeds was counted. Results of each Farm showed clearly its agronomic background. Thus, in 'Campo Olmos', example of first cropping season in the field, strawberry or any other crop, 95% of

weeds were a native specie known as “vidrillo” (*Batis maritima*) (pickleweed) (Table 3). In “Rancho Don Juanito”, example of continued and sustained cultivation of strawberry every year with MB:Pic mixture, 99% of weeds were *Malva* spp. (Table 4). In 'Santa Monica', example of intensive cultivation for a few years and alternating fumigants, weeds were not found in the beds. These data point out that, unlike other areas devoted to strawberries production, weed control is not a key factor in the use of alternatives to MB in the San Quintin Valley (Baja Califonia, Mexico). The fact that transparent plastic was used as mulching in all the Farms and demonstrations, confirms this assertion.

Yield and fruit size: Marketable yield is the most important result in this kind of field demonstrations. 50 random plants were marked in each demonstration in every farm. In each collection, weight and number of marketable fruits per plant were recorded. The harvest began in the early days of January 2008 and continued until the last days of June 2008. Results were very similar in every demonstration Farm. For a fine interpretation of the results, it is important to consider that only weights and quality of the absolutely healthy fruits were recorded. These values are smaller than the actual yields and should be used just as estimations of potential yields in the demonstrations and do not reflect the current yields of the Farms. The harvest in the early stage is the accumulated until the last week of March 2008 (Table 5). Early yields and fruit sizes, were very similar in all the demonstrations in all the fields.

Yield obtained in April (intermediate stage) was not recorded. The control of production from May to June (medium-final stage) 2008 (Table 6) was continued following the same methodology than for the early stages. The production accumulated in the medium-final stage of the growing season confirmed a great similarity of results in each of the three Farms, for all the demonstrations. No significant differences were found ($\leq$ (0.05) in the number and fruits weight in ‘Rancho Don Juanito’ and “Santa Monica”, while in “Campo Olmos”, demonstration T1 (MB:pic 50:50) obtained the worst results. In general, fruits from demonstrations T1 were slightly bigger than in other demonstrative treatments except in “Campo Olmos”, anyway a high relationship between treatments and size of fruits was not found.

CONCLUSIONS

Preliminary results obtained in the Pilot Project SEMARNAT/UNIDO on MB alternatives for strawberry in the San Quintin Valley (Baja California, Mexico), have shown a high similarity between fumigant treatments. After 25-31 collections, yields and average fruits weight did not revealed differences between the demonstration T1 (MB:pic 50:50, 400 kg/ha), similar to the standard treatment in the region (MB:pic 75:25, 392 kg/ha) and the rest of the treatments. These provisional results, must be seen from the perspective of a single year of experiments. We are moving towards a second year using the same fumigants in the same demonstration plots to determine the behaviour over a number of strawberry growing seasons.

Table 1.- MB alternatives for strawberry. Demonstration fields. Baja California (Mexico). 2007-2008.

Demonstration	Active ingredient	Trade mark	Rate	Application	Company
T0: Don Juanito and Campo Olmos	MB:chloropicrin 75:25 w/w		392 kg/ha (350 lb/ac)	Broadcast shank-application	Trical de Baja California
T0: Santa Mónica	1,3-dichloropropene: chloropicrin	Piclor 35 EC	500 kg/ha	Pre-plant drip irrigation on beds	Trical de Baja California
T1	MB:chloropicrin 50:50 w/w	Tri-Con 50/50 EC	400 kg/ha	Broadcast shank-application	Trical de Baja California
T2	Chloropicrin	Tri-clor EC	500 kg/ha	Pre-plant drip irrigation on beds	Trical de Baja California
T3	1,3-dichloropropene: chloropicrin	Piclor 35 EC	500 kg/ha	Pre-plant drip irrigation on beds	Trical de Baja California
T4	Metam potassium	Busan 69 GE	500-750 l/ha	Pre-plant drip irrigation on beds	Buckman
T5: Don Juanito y Santa Mónica	Metam sodium	Lucafum 516	1000 l/ha	Pre-plant drip irrigation on beds	Buckman
T5: Campo Olmos	Methyl iodide: chloropicrin 33:67 w/w	Midas	370 kg/ha	Pre-plant drip irrigation on beds	Arysta
T0: Overall fumigation standard in the Farm.					

Table 2.- Replanting percentage (% of death plants after planting).

Demonstration	Farms		
	Don Juanito (plants/bed: 637)	Campo Olmos (plants/bed: 1072)	Santa Mónica (plants/bed: 828)
T1 (MB:Pic 50:50)	0.85 b*	1.42 a	0.68 a
T2 (Pic)	0.91 b	1.42 a	0.65 a
T3 (1,3D:Pic)	1.79 a	1.51 a	0.92 a
T4 (MK)	1.76 a	1.36 a	0.99 a
T5 (MS)	1.63 a	1.34 a**	0.94 a
*Means followed by the same letter in each column were not significantly different (0.5 P) by the LSD test. **T5: Methyl iodide: chloropicrin 33:67 w/w (Midas)			

Table 3.- Weed control in 'Campo Olmos' Farm. Number of removed weeds per square meter of bed.

Demonstration	Control Nov. 27, 2007	Control Jan. 9, 2008	Control Jan. 28, 2008	Total of three controls
T1 (MB:Pic 50:50)	2.13 b*	2.67 b	1.60 b	6.40 c
T2 (Pic)	20.27 a	14.40 a	5.60 a	40.27 a
T3 (1,3D:Pic)	4.27 b	18.67 a	5.07 a	28.00 b
T4 (MK)	1.07 b	2.40 b	1.60 b	5.07 c
T5 (IM:Pic)	1.33 b	1.33 b	1.87 b	4.53 c
*Means followed by the same letter in each column were not significantly different (0.5P) by the LSD test.				

Table 4.- Weed control in 'Don Juanito' Farm. Number of removed weeds per square meter of bed.

Demonstration	Control Oct. 6-12, 2007	Control Nov. 3-10, 2007	Total of both controls
T1 (MB:Pic 50:50)	13.33 a*	28.80 a	42.13 a
T2 (Pic)	4.27 b	37.87 a	42.13 a
T3 (1,3D:Pic)	3.73 b	26.13 a	29.87 a
T4 (MK)	3.20 b	28.00 a	31.20 a
T5 (MS)	4.00 b	29.33 a	33.33 a
*Means followed by the same letter in each column were not significantly different (0.5 ≤ P) by the LSD test.			

Table 5.- Early yield (up-to end-March, 2008)

Farm	Demonstration	Harvest period	Nº of collections	Nº of fruits harvested per 50 plants	Weight in kg harvested per 50 plants	Averaged fruit weight (g)
D.Juanito	T1 (MB:Pic)	1/12-3/24	14	143	5.58	39.0
	T2 (Pic)			171	6.61	38.7
	T3 (1,3D:Pic)			198	6.74	34.1
	T4 (MK)			204	6.10	29.9
	T5 (MS)			214	7.35	34.4
C. Olmos	T1 (MB:Pic)	1/17-3/27	10	96	3.22	33.5
	T2 (Pic)			95	2.85	29.9
	T3 (1,3D:Pic)			117	3.00	25.6
	T4 (MK)			115	2.97	25.8
	T5 (IM:Pic)			125	3.47	27.8
S.Mónica	T1 (MB:Pic)	1/5-3/25	13	175	5.63	32.2
	T2 (Pic)			194	5.89	30.4
	T3 (1,3D:Pic)			168	5.18	30.8
	T4 (MK)			227	6.26	27.6
	T5 (MS)			205	6.24	30.4

Table 6.- Medium-Final yield (May-June, 2008)

Farm	Demonstration	Harvest period	Nº of collec-tions	Nº of fruits harvested per 50 plants	Weight in kg harvested per 50 plants	Averaged fruit weight (g)
D. Juanito	T1 (MB:Pic)	5/5-6/20	11	466 a*	7.15 a	15.3 a
	T2 (Pic)			501 a	7.42 a	14.8 a
	T3 (1,3D:Pic)			492 a	6.49 a	13.2 b
	T4 (MK)			506 a	7.24 a	14.3 a
	T5 (MS)			483 a	6.97 a	14.4 a
C. Olmos	T1 (MB:Pic)	5/5-6/17	10	305 b	4.61 c	15.1 a
	T2 (Pic)			359 a	5.03 bc	14.0 b
	T3 (1,3D:Pic)			365 a	5.07 abc	13.9 b
	T4 (MK)			358 a	5.59 ab	15.6 a
	T5 (IM:Pic)			362 a	5.63 a	15.5 a
S. Mónica	T1 (MB:Pic)	5/5-6/27	9	561 a	8.22 a	14.7 a
	T2 (Pic)			548 a	7.97 a	14.5 a
	T3 (1,3D:Pic)			543 a	7.43 a	13.7 b
	T4 (MK)			547 a	7.39 a	13.5 b
	T5 (MS)			546 a	7.57 a	13.9 b
*Means followed by the same letter in each column and Farm were not significantly different (0.5 ≤ P) by the LSD test.						