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06218



Distr.  
LIMITED

ID/WG.184/16  
26 February 1975

ENGLISH  
ORIGINAL: FRENCH

United Nations Industrial Development Organization

Symposium on the Development of the  
Plastics Industry in Latin America

Buenos Aires, Argentina, 8-17 September 1974

THE DEVELOPMENT OF THE USE OF PLASTICS IN FRENCH AGRICULTURE ✓

by

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✓ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO.



## GENERAL OBSERVATIONS

Among the techniques that have had a profound effect on the progress of French agriculture during the last fifteen years "plasticulture" - that is, the use of plastics in agriculture - occupies an important position. Thanks to the efforts of the French National Committee for the Use of Plastics in Agriculture, which has played a major role in this development, synthetic materials are now being used in most areas of agricultural activity.

In 1973 France consumed nearly 200,000 tonnes of plastics for agricultural purposes, a figure which represents about 8 per cent of all the plastics used in our country.

These 200,000 tonnes break down as follows:

### Cultivation techniques

Mulching, small tunnels, large shelters and greenhouses;	
Irrigation, drainage,	
Containers;	
Ensilage, water storage areas;	
Wind-breaks, shading screens, hail screens.	57,000 tonnes

### Packaging

Fertilizer;	
Pesticides;	
Seeds.	60,000 tonnes

### Packaging of agricultural products

Fruits;	
Vegetables.	61,000 tonnes

### Miscellaneous applications

Transport and storage tanks;	
Farm machinery;	
Farm buildings.	17,000 tonnes
	<hr/>
	195,000 tonnes

### THE PRINCIPAL MATERIALS USED (percentages and tonnage)

Like many other countries, France uses large quantities of polyethylene. Expressed in percentages, the breakdown among the different plastic materials is as follows:

Polyethylene, low-density	(PE ld)	5%
Polyethylene, high-density	(PE hd)	15%
Polyvinyl chloride	(PVC)	9%
Polyester	(Pr)	5%
Polypropylene	(PP)	3%
Polystyrene	(PST)	2%
Others		1%

The actual situation can be somewhat more easily visualized by considering the tonnages consumed for each major category of use:

#### 1. Cultivation techniques

Films	{ 40,000 tonnes PE ld 3,000 to 4,000 tonnes PVC	
Pipes (irrigation and drainage)	{ 6,000 tonnes PVC 3,000 tonnes PE ld	
Flat pieces, pots, wind-breaks, shading mats, hail screens	{ 4,000 tonnes	
	-----	
	57,000 tonnes	57,000 tonnes

#### 2. Bag production

Fertilizers, pesticides, seeds	{ 50,000 tonnes PE ld 5,000 tonnes PE hd 5,000 tonnes PP	
	-----	
	60,000 tonnes	60,000 tonnes

#### 3. Packaging

Fruits and vegetables	30,000 tonnes PE ld	
Milk (collection, storage, delivery, presentation)	{ 25,000 tonnes PE hd 4,000 tonnes PST 2,000 tonnes PVC	
	-----	
	61,000 tonnes	61,000 tonnes

#### 4. Storage and transport tanks

Milk, wine, liquid fertilizers	{ 10,000 tonnes Pr 2,000 tonnes PE ld	
Farm machinery and buildings	{ 1,000 tonnes PVC 3,000 tonnes PST 1,000 tonnes other materials	
	-----	
	17,000 tonnes	17,000 tonnes

## THE VARIOUS USES

We shall restrict our account to cultivation-related uses. Our purpose will be to give as clear a picture as possible of each application and to indicate the trends which can be identified.

1. Mulching

Our country stands second in the world - immediately after Japan - in terms of land area under mulching.

A total of 33,000 hectares have been mulched, the distribution being as follows:

Annual plants	(melons	10,000 hectares
	{strawberries	6,500 "
	{asparagus	4,000 "
	{tomatoes	2,000 "
	{miscellaneous	2,000 "
Perennial plants	vines	8,000 "
Fruit and nursery trees		500 "
		<hr/>
		33,000 hectares

The material most often used is transparent film, 30 to 50 microns in thickness, for the purpose of achieving early ripening. These films are used for virtually all the acreage under melons and asparagus.

In the case of tomatoes and strawberries, depending on the density of weeds, the soil may be covered with either transparent or black film.

For vines and fruit-trees, the mulch will probably remain in place for three or four years; accordingly, thicker black film of better quality should be used.

Among recent trends we might note:

## A. The commercial availability of:

- (a) Opaque thermal PE and green PVC films. These new materials simultaneously ensure early ripening, comparable to that which is possible with the transparent films, plus good weed control. Their price is still relatively high;
- (b) Films which are photo-degradable after one, two or three months. These films are beginning to come into use, particularly in the growing of maize, for which yields have increased, in northern France, from 20 to 25 tonnes per hectare;
- (c) Anti-fogging films, which are much sought after and valued as covers for asparagus shoots.

B. The frequent use of mulching for cultivation under small tunnels and shelters of the greenhouse type.

Mulching by means of black film is currently being used for the protected growing of lettuce in the region of the Eastern Pyrenees.

Soil coverage is finding increasing application in conjunction with the use of modern irrigation systems, especially the drop by-drop method, in greenhouses.

## 2. Small tunnels

Because of the labour requirement involved, the use of small tunnels has developed, although steadily, at a slower pace than the preceding technique. Some 11,000 hectares of land are currently protected in this way, putting France in fourth place among the world's nations, behind Israel, Japan and Greece.

Tunnels are widely used particularly in the south of France: the Rhone valley, the Mediterranean coast and the Garonne valley. They are also very extensively employed in the Loire valley and, along the sea coast, in Brittany.

Three quarters of the protected acreage is under melons and strawberries. Other vegetable varieties - tomatoes, pimento, egg-plant, kidney beans - are temporarily protected, because of their spatial requirements, for a limited period at the beginning of spring.

While polyethylene films are used most frequently in the spring, winter shelters, particularly for strawberries, employ PVC film.

An infra-red polyethylene variety, with distinctly improved strength characteristics has recently been developed, which ensures slightly better results with respect to early ripening than those obtained with simple polyethylene.

The so-called "Nantais" double-arch tunnel continues to be widely used on small farms. When the area to be protected is more extensive, the film is mechanically installed and buried on both sides. This film, which is at first continuous, is gradually perforated (the holes being 10 cm in diameter). With this system the time required to ventilate the plants can be reduced.

In southern regions, small tunnels are being used with increasing frequency inside large unheated shelters to provide temporary protection against the cold. This arrangement makes it possible to achieve a temperature gain of 3° to 6° C relative to the external temperature. For most plants, harvesting can then begin about ten days earlier than otherwise.

### 3. Greenhouses and shelters of the greenhouse type

The development of large plastic-covered shelters has proceeded in France at a far slower pace than either mulching or semi-forcing. This slower rate of development can be traced to three main reasons:

First of all, most of the regions intensively farmed for vegetables are swept by violent winds.

Secondly, even in the southern regions winter temperatures are relatively low and at distances of more than 30 km from the sea regularly drop to  $-8^{\circ}$  C.

Finally, by temperament, the French prefer more elaborate structures.

It was only in the face of a deteriorating economic situation that the light shelter has been able to make inroads on the heavy glass-covered greenhouse. Currently, in 1974, greenhouses account for approximately 1,200 hectares under cover, with plastic shelters protecting 1,500 hectares.

As in the case of the small tunnels, such shelters are found in great number in areas of the South where the light is very intense, and particularly on the plain of Berre, near Marseille and on the plain of Roussillon near the border with Spain.

Because of the very high winds already mentioned, which blow at velocities greater than 16 metres per second on an average of more than 100 days a year, it has been necessary to design shelters capable of withstanding high pressure. It is for this reason that the majority of basic frame structures, which in other regions of the Mediterranean basin (Sicily, Greece, etc.) are fashioned of wood, are built of metal in France. The same circumstance also explains why the semicircular configuration, which affords less wind resistance, is the predominant design in almost all French farming areas.

In view of the drops in winter temperatures encountered in most of the market-gardening regions, it has also been necessary to ensure that the shelters are sufficiently well sealed to contribute a degree of warmth.

Additionally, as we have noted above, economic considerations have not been disregarded in the design of these structures. The grower's aim is to minimize his initial investment, with the result that one finds very simple shelters in the form of large tunnels 6 to 8 m long, either erected on the spot or commercially supplied. Again, for the purpose of holding down the sales price, these shelters are often not equipped with mechanical openings; for ventilation, the films are simply pushed aside by hand.



Although not as common, considerably more capacious tunnels are found having a ground-level width of 8.5 to 9 m and a top-to-bottom height of 3.2 m. For tighter sealing, these tunnels are equipped with a layer of tubing to permit the formation of an air cushion 1 to 3 cm thick. This type of more elaborate shelter is provided with lateral openings.

In Mediterranean coastal regions where the climate is very mild, one encounters a type of shelter referred to as a "covered garden", which has the shape of a series of peaked arches. The films are not joined together either at the top or along the sides, thus ensuring continuous ventilation. This system functions as a wind-break and rain-shield, but does not protect the plants against the effects of low temperature. It represents a compromise solution between open-field farming and the greenhouse.

The outlay per square metre required for these different shelter types run as follows:

12 to 16 francs for simple 7-metre tunnels;

30 to 35 francs for the large tunnels and "covered gardens".

Virtually all the protected acreage is planted with lettuce during the winter season. Greater diversification is found in the spring plantings:

Tomato over 75 per cent of the areas;

Melon over 15 per cent of the areas;

Peppers, egg-plant and other crops over 10 per cent of the areas.

It might be noted that about one hundred hectares of tunnels are used for tobacco drying.

Continuing our discussion of trends, there has been an increasing acceptance, during the last three years, of light-weight shelters for use in floriculture. These structures can be found over about one hundred hectares along the Mediterranean coast. The flower varieties most commonly grown are the anemone, the ranunculus and the carnation.

Another current development, spurred by the desire to reduce labour costs through the elimination of ventilation operations, can be seen in the testing of forced-air ventilation systems under simple shelters. Advances in this technique have profited from the arrival on the market of high-power fans.

There has also been progress in the choice of covering materials. Although polyethylene is used in 90 per cent of the covered areas, almost all the films have been considerably improved (very low grades 0.3, and the addition of ultraviolet absorbents) and have a service life of more than 23 months.

The quality of PVC films is also better. Beginning with this year, growers can purchase films measuring 200 microns in thickness and 4 metres in length with four-year guarantees.

Finally, experiments have been in progress for two years in France involving new films based on an ethylene vinyl acetate copolymer and known by the designation EVA.

The results achieved, from both the practical and the agricultural standpoint, are promising. Although they have not yet been fully developed, it is already evident that these films offer an average service life of 18 months and that the properties of the thermal film are very close to those of the PVC variety. The conditions for plant development are as favourable as under this last-mentioned material during periods of low temperatures and limited light.

#### 4. Irrigation and drainage

##### (a) Irrigation

Along with irrigation by sprinkling with its increasing use of plastic pipes, a variety of localized irrigation systems are under development, particularly the "drop-by-drop" system.

There are at the present time in France 2,000 hectares under localized irrigation, distributed as follows:

- 45 per cent for fruit-trees,
- 40 per cent for vines;
- 10 per cent for containers and greenhouses;
- 5 per cent for market gardening.

This new method of irrigation has gained a certain prominence in Corsica, where it is being used to water 1,200 hectares.

##### (b) Drainage

Following several decades of neglect, this technique has recently been revitalized, with installations increasing in France at the rate of 20 to 30 per cent per annum over the last five years. In 1973, more than 25,000 hectares were being drained.

This sudden reawakening of interest has been triggered by the conjunction of two factors: first, the appearance on the market of very long, ringed PVC drains; secondly, the use of powerful equipment capable of excavating very deep ditches at high speed.

As a result of these two technical advances it has been possible, during the last ten years, to reduce drainage costs by one half, as computed in constant francs. The average sale price of a drainage system today is about 4,500 francs per hectare.

#### 5. Wind-breaks

A large number of nets and lattice-work screens, often using high-density polyethylene and having a porosity factor of 50 and 30 per cent, have been tested at the laboratories and experimental stations of the National Institute of Agricultural Research. In both Brittany and the south of France, 5 to 15 per cent greater yields and also slightly earlier ripening have been observed.

Because of their sales price, which can be as high as 15 francs per linear metre for two-metre-high netting, these devices, despite their tested advantages, have not yet supplanted dead reed hedges for use as wind-breaks.

It is also worth noting that in the Perpignan region there is an increasing tendency to use netting 1.2 m in height for the protection of lettuce grown in the open field. Some 100 kilometres of artificial hedges are installed in the fall and taken down after harvesting has been concluded.

#### 6. Hail screens

Despite conclusive experimental results, French nurserymen are reluctant to spend 27,000 francs per hectare to protect their trees against hail. The fact that the element of risk is smaller than in certain arboricultural regions of Northern Italy may explain the lack of enthusiasm for the use of hail screens, a method which, when its costs are amortized over a full year, turns out to be no more expensive than an insurance premium, while affording the following advantages no insurance can provide:

Practically 100-per-cent avoidance of damage by hail to unharvested crops;

Total protection of the trees, thereby retaining their production potential for future years.

#### 7. Ensilage of fodder

Since 1973, the use of films for ensilage has increased in France to more than 20,000 tonnes. The largest amounts (75 per cent of total use) are used primarily in the cattle-raising regions of the West (Normandy, Brittany, Vendée, Deux-Sèvres).

Of these films, 98 per cent are polyethylene and the rest plasticized polyvinyl chloride.

Three types of silos are available on the market:

The mound-type silo, which because of its low cost is the most common.

The chute-equipped silo, which has been developed mainly since the 1971-1972 period. This type of silo is well suited for the feeding of large herds in the open.

The "silorax" silo, which is an improved version of the mound silo in that it permits storage in a vacuum.

Up until a few years ago thin black films of average quality were used in silos. At the present time, stock-breeders are using films of more than 150 microns in thickness. It should also be noted that there are now available on the market special films of a little more than 100 microns in thickness which offer great strength and outstanding resistance to puncture and the effects of sunlight.

#### 8. Container growing

Plastic containers are gaining increasing acceptance in horticulture, where they are displacing the traditional clay pot.

For the growing of house plants alone containers now account for the consumption of some 1,000 tonnes of plastic

The advantages of this method outweigh the drawbacks: a 1-to-2-degree-higher temperature resulting in faster growth, excellent rooting, ease of planting, guaranteed survival, limited care required, uniform periods of cultivation and sale, greater ease of storage, etc.

Indeed, the term "drawback" seems inappropriate. The problem here is mostly a technical one: preparation of the soil, choice of substrates, fertilization and proper irrigation.

#### 9. Miscellaneous applications

These applications are less directly related to agriculture and will doubtless be discussed in other papers. Examples are the packaging materials used at earlier and later stages in the production process, receptacles of all types (such as grape baskets, storage containers for fruit juices, wine, milk, etc.), transport tanks, and finally agricultural machinery and livestock structures, for which large amounts of plastics are also employed.

### CONCLUSIONS

We have endeavoured in this brief survey to identify and summarize the major development trends in the use of plastics in different areas of French agriculture. The annual rate of increase in this important sector during the last three years has been in the order of 18 per cent - that is, in line with the average growth curve of plastics consumption in France.

While the techniques for many applications have by this time been well perfected, new possibilities are continually presenting themselves which bring with them new problems. These problems are serious and arise at different levels.

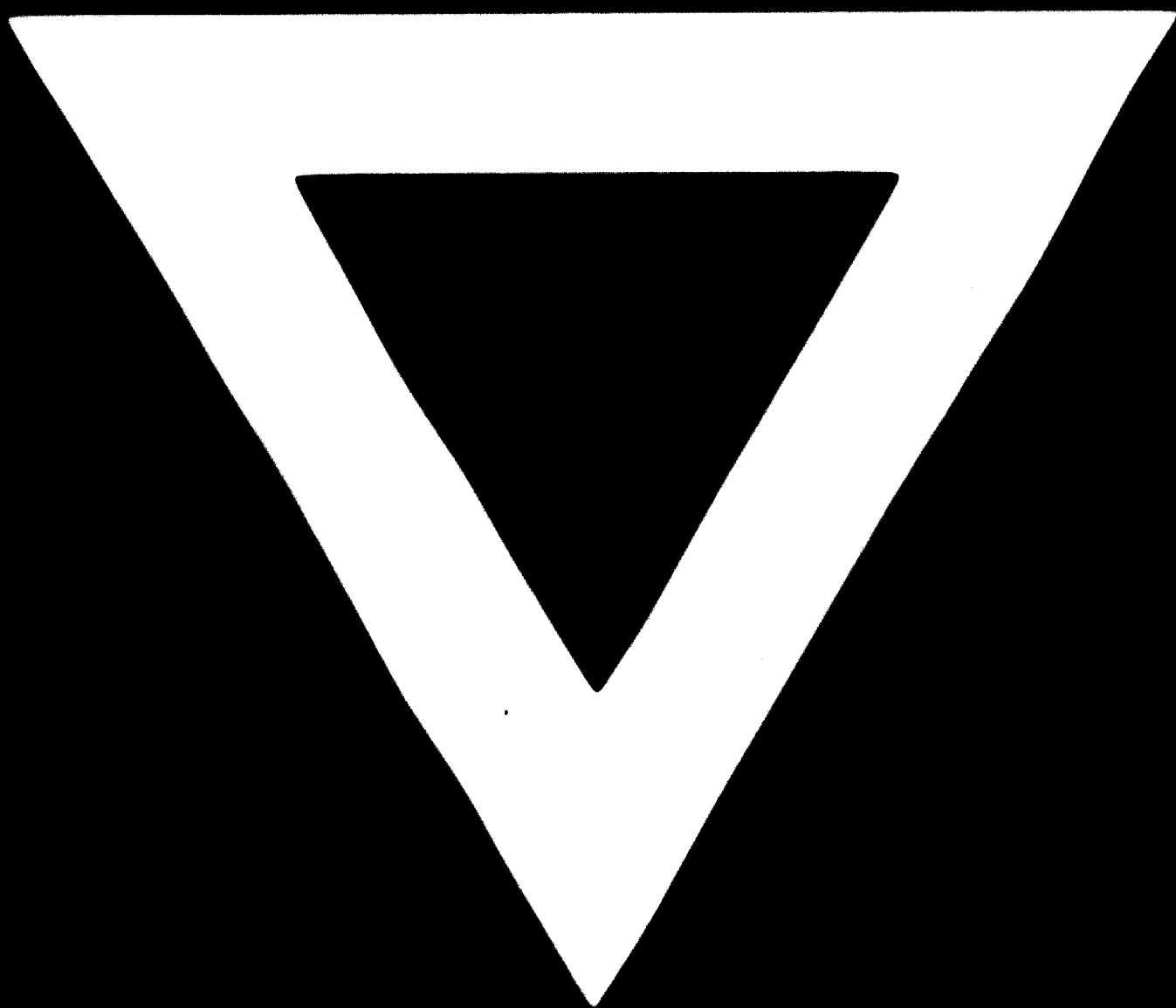
To facilitate a freer exchange of information between all the parties concerned - researchers, experimenters, popularizers, industrialists and users - Mr. Duclon, the Secretary-General of the French National Committee on Plastics in Agriculture, established in 1969 a number of commissions (Agricultural Research, Industry, etc.), which meet once or twice a year. Five of these commissions are operating on a regular basis. They are:

- Commission on Greenhouses and Shelters;
- Commission on Cultivation Techniques;
- Commission on Wind-breaks;
- Commission on Container Growing;
- Commission on Ensilage.

These meetings provide a forum at which the different problems confronting the various participants can be extensively discussed in an effort to achieve full co-operation. There is no doubt but that this highly constructive attitude is fundamentally responsible for the spectacular progress which our country has achieved during the last ten years.

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**75.08.11**