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PROTECTION POSSIBILITIES OF ORGANIC CROPS USING PLANT OILS IN THE EUROPEAN UNION

Summary

Only products containing substances listed in the Regulations (EC) No 889/2008 and 354/2014 can be used in the protection of organic crops. Despite the common list of active substances and schemes of qualifying products for use in organic farming, availability of measures to protect organic farming in the Member States vary widely. The paper presents data collected in 2017. Obtaining information concerning the list of plant protection products qualified for use in organic farming was possible only for 12 Member States. Among the countries, the biggest number of products containing plant oils to protect organic crops has been approved in Germany, the Czech Republic and Luxembourg. No products containing plant oils are approved for use in organic farming in Croatia, Lithuania, Poland and United Kingdom. Pinole and rapeseed oil have the broadest protection capacity for each group of organic farming: agricultural, vegetable, fruit and ornamental. Plant oils most frequently registered in the products approved for use in organic farming include rapeseed oil, mint oil and orange oil. Differences in the availability of ways to protect organic farming in the Member States hinder equal competition in the common market.
***Key words**: organic farming, plant protection, availability, plant oils, European Union*

MOŻLIWOŚCI OCHRONY UPRAW EKOLOGICZNYCH W UNII EUROPEJSKIEJ PRZY WYKORZYSTANIU ŚRODKÓW ZAWIERAJĄCYCH OLEJE ROŚLINNE

Streszczenie

Do ochrony upraw ekologicznych dopuszczone są tylko środki zawierające substancje wymienione w Rozporządzeniach Komisji (WE) nr 889/2008 oraz 354/2014. Mimo wspólnej listy substancji aktywnych systemy kwalifikowania preparatów do stosowania w rolnictwie ekologicznym oraz dostępność środków do ochrony upraw ekologicznych w poszczególnych państwach członkowskich są bardzo zróżnicowane. W artykule zaprezentowano dane zebrane w roku 2017. Uzyskanie informacji dotyczących listy środków ochrony roślin zakwalifikowanych do stosowania w rolnictwie ekologicznym było możliwe dla 12 państw członkowskich. Wśród tych państw najwięcej środków zawierających oleje roślinne dopuszczonych jest w Niemczech, Czechach oraz Luksemburgu. W Chorwacji, Litwie, Polsce i Wielkiej Brytanii brak jest środków zawierających oleje roślinne dopuszczonych do stosowania w uprawach ekologicznych. Olejki pozyskiwane z sosny i olej rzepakowy posiadają najszersze możliwości ochrony dla każdej grupy upraw ekologicznych: rolniczych warzywniczych, sadowniczych i ozdobnych. Oleje roślinne najczęściej rejestrowane w środkach dopuszczonych do stosowania w rolnictwie ekologicznym to olej rzepakowy, olejek miętowy i olejek pomarańczowy. Różnice w dostępności możliwości ochrony upraw ekologicznych w poszczególnych państwach członkowskich utrudniają równorzędną konkurencję na wspólnym rynku.
***Słowa kluczowe**: rolnictwo ekologiczne, ochrona roślin, dostępność, oleje roślinne, Unia Europejska*

1. Introduction

Currently the European Union has almost 270 thousand organic farms with a total acreage of over 11,2 million hectares [13]. Many harmful organisms threaten organic crops, as well as other crops [7]. Regulations allow for the use of certain plant protection products to reduce the number of these organisms. In organic farming only active substances listed in the Regulations (EC) No 889/2008 and 354/2014 can be used [15, 16]. These provisions are common across the European Union, but despite this the availability of plant protection products in the various Member States differs quite significantly [3, 8]. It results from the fact that individual Member States have different climatic conditions, different crops, and a separate system of qualification of plant protection products for use in organic farming.

The aim of the study was to compare the availability of products containing plant oils in the Member States of the European Union.

2. Material and methods

An overview of lists of products to protect organic farming in the European Union was carried out in 2017. For the analysis the lists of products approved for organic farming protection in 12 European Union Member States: Belgium, Croatia, Czech Republic, France, Germany, Great Britain, Hungary, Italy, Luxemburg, Poland, Slovakia and Sweden were used [1, 2, 4, 5, 6, 9, 10, 11, 12, 14, 17, 18, 19].
In the remaining 16 Member States either there were no official lists recorded of protection products designed for organic farming (Denmark, Estonia, Greece, the Netherlands, Ireland, Latvia and Romania), or obtaining information about such lists was very difficult (e.g. Spain and Portugal).

Material for the study comes from the official websites dedicated to organic farming within the Member States. We analysed all the products containing plant oils approved for use in organic farming. Based on the labels of the products, protected crop species were identified. The crops were then divided into four groups: agricultural, vegetable, fruit and ornamental.

3. Results and discussion

Collective data on plant oils approved for use in organic farming in 8 out of the 12 analysed Member States is presented in Table 1 (in the remaining 4 Member States there were no such products).

Table 1. List of plant oils approved for use in organic farming in the European Union
Tab. 1. Wykaz olejów roślinnych dopuszczonych do stosowania w rolnictwie ekologicznym w Unii Europejskiej

Country	Total number of registered products containing plant oils	The plant oils and number of registered products for each one of them
Belgium	7	mint oil - 1 orange oil - 1 rapeseed oil - 2 pyrethrins, rapeseed oil - 3
Czech Republic	14	fennel oil -1 *Pongamia pinnata* oil - 1 rapeseed oil - 3 soybean oil - 1 linseed oil, *Pongamia pinnata* oil - 1 rapeseed oil, lecithin - 2 pyrethrins, rapeseed oil - 5
France	3	mint oil - 1 rapeseed oil - 2
Luxemburg	11	rapeseed oil - 2 esterified rapeseed oil - 1 azadirachtin, rapeseed oil - 1 pyrethrins, rapeseed oil - 7
Germany	49	mint oil - 1 orange oil - 1 rapeseed oil - 22 pyrethrins, rapeseed oil - 25
Slovakia	3	fennel oil -1 orange oil - 1 pinole -1
Hungary	2	sunflower oil - 1 plant oils/polyethoxylade rapeseed oil - 1
Italy	2	gillyflower oil - 1 mint oil - 1

Source: own work / Źródło: opracowanie własne

The majority of products containing plant oils approved for use in organic farming are in Germany (49), Czech Republic (14) and Luxemburg (11). The minority are in Hungary (2) and Italy (2). Currently, the following plant oils are used in organic agriculture of the analyzed Member States: mint oil, orange oil, rapeseed oil, fennel oil, *Pongamia pinnata* oil, soybean oil, linseed oil, pinole, sunflower oil and gillyflower oil. Some approved products contain mixtures of substances, such as: azadirachtin and rapeseed oil, linseed oil and *Pongamia pinnata* oil, rapeseed oil and lecithin, pyrethrins and rapeseed oil. No products containing plant oils are approved to use in organic farming in Croation, Lithuania, Poland and United Kingdom.

Czech Republic has the biggest availability of products containing different plant oils to protect organic crops. Slovakia, Hungary and Italy have several products available. Mint oil, orange oil and rapeseed oil are most widely used among plant oils and they are approved for use in organic farming almost throughout the entire European Union. Products containing a mixture of pyrethrins and rapeseed oil are the most popular in Belgium, Czech Republic, Luxemburg and Germany.

Products containing plant oils are registered mostly to protect crops against pests and diseases. However, some of them are approved as well as plant growth regulators, for example as resistance inductors, plant strengtheners, sprouting stimulators, adjuvants or to stimulate health or physiological activity of crop plant.

Table 2 illustrates the scope of use of products containing plant oils, while Table 3 shows the numerical data on registered products including protected crop species. These species were divided into four groups: agricultural, vegetable, orchard and ornamental plants. Among the agricultural species the plant protection product labelling showed: sugar and fodder beet, hop, clover, corn, field pea, oilseed rape, sunflower, grass fodder, cereals (spring and winter wheat as well as spelt, spring and winter barley, spring and winter rye, spring and winter triticale), cabbage turnip and potato. The most products containing plant oil to protect agriculture crops can be found in Germany (11), and less in France, Hungary and Italy (1).

Among the vegetable species protection included: aubergine, basil, broccoli, Brussel sprout, beetroot, onion, zucchini, radish, garlic, small onion bulb, pumpkin, tarragon, bean, green beans, cauliflower, kohlrabi, common cabbage, Chinese cabbage, caraway, coriander, dill, fennel, garden lovage, carrot, mint, cucumber, oregano, pak choi, pepper, parsnip, pepino, parsley, tomato, leek, rhubarb, lamb's lettuce, rosemary, sprouts, lettuce, celeriac, black salsify, eshalot, chive, garden asparagus, spinach, topinambur, cucumber vegetables, onion vegetables, root vegetables, tuber vegetables, leaves vegetables, cabbage vegetables, fruit vegetables, rutabaga, celery, skorzonera, chervil, legume vegetables, laurel, herbs, medicine plants, sorrel, borage and pea. Most plant protection products containing plant oils and approved for the protection of vegetables can be found in Germany (48), and less in Hungary (2) and Slovakia (3). No products are registered in Italy and France.

Among organic crops, orchard species occupy an important place, often mentioned in the labelling. It is possible to use plant oils in the protection of the following orchard species: berries (highbush blueberry, berry, blackberry, raspberry, tayberry, gooseberry, cranberry, currant), stone fruit (peach, sweet cherry, nectarine, plum, sour cherry), pome fruit (pear, apple), chestnut, strawberry and grape. Germany (46) dominates in terms of the number of products containing plant oils for the protection of ecological orchards. A few products for this group of crops were recorded in Hungary and France and one in Italy.

The group of ornamental plants grown organically is most often trees and shrubs (poplar, oleander, rose, azalea, hortensia, rhodies) and conifer (spruce, larch, yew), flowering (chrysanthemum, carnation, begonia, pelargonium, gerbera), house plant (rubber plant, dracaena, philodendron, fern, mother-in-law's-tongue, spathe flower, dumbcane, flamingo flower, croton, *Bromelia*), balcony flowers, lawn and golf course, park and public gardens as well as greenhouses and nursery. 48 products containing plant oils for protection of ornamental plants are authorised in Germany and 13 in Czech Republic. Hungary and France have only two. No products containing plant oils are approved for ornamentals protection in Italy.

The labels often do not have any definite crop varieties, and they are described in very general terms, e.g. different kinds of vegetables, orchards, ornamental plants and flowers or agricultural plants. Such a system helps to expand the scope of application of the products containing plant oils.

Table 2. List of plant oils to protect individual crop groups in the European Union
Tab. 2. Wykaz olejów roślinnych do ochrony poszczególnych grup roślin uprawnych w Unii Europejskiej

Plant oils	Number of approved products	Range of use
gillyflower oil	1	**Fruit trees and shrubs**: apple and pear (storage disease)
fennel oil	2	**Vegetable plants:** lamb's lettuce (inductive resistance and plant strengthening), vegetables (powdery mildews), cucurbit vegetables (inductive resistance and plant strengthening) **Fruit trees and shrubs:** gooseberry (powdery mildews, grey mould, American gooseberry mildew, inductive resistance and plant strengthening), currant (powdery mildews, grey mould, American gooseberry mildew, inductive resistance and plant strengthening), strawberry (powdery mildews, grey mould, American gooseberry mildew, inductive resistance and plant strengthening), grape (powdery mildews, grey mould, inductive resistance and plant strengthening) **Ornamental plants**: ornamental plants (powdery mildews, inductive resistance and plant strengthening)
mint oil	4	**Agriculture crops:** potato (sprouting stimulation, growth regulator)
pinole	1	**Agriculture crops:** rape, wheat, sunflower, pea, clover for seeds, grass for seeds, hop, barley spring, arable land (befor sowing or planting, stubble) (increasing the resistance of the application liquid to the rain, reducing the surface tension of the, increasing the absorbency, effect on seed drying, reducing harvest losses, shortening the preharvest interval) **Vegetable crops:** onion for seeds (increasing the resistance of the application liquid to the rain, reducing the surface tension of the, increasing the absorbency, effect on seed drying, reducing harvest losses, shortening the preharvest interval) **Fruit trees and shrubs:** orchard, vineyards (increasing the resistance of the application liquid to the rain, reducing the surface tension of the, increasing the absorbency, effect on seed drying, reducing harvest losses, shortening the preharvest interval) **Forest stands, all non-agricultural crops, preparation of soil for afforestation, railroad tracks, all plants** (increasing the resistance of the application liquid to the rain, reducing the surface tension of the, increasing the absorbency, effect on seed drying, reducing harvest losses, shortening the preharvest interval)
Pongamia pinnata oil	1	**Agriculture crops:** hop (increasing crop resistance) **Vegetable crops**: pumpkin, bean, cucumber, pepper, tomato (increasing crop resistance) **Fruit trees and shrubs**: gooseberry, stone and pome fruits, current, grape (increasing crop resistance) **Ornamental plants**: conifers, ornamental plants (increasing crop resistance)
orange oil	3	**Vegetable crops:** aubergine, pepino under cover (whitefly), pumpkin in the ground and under cover (whitefly), cucumber in the ground and under cover (whitefly), pepper under cover (whitefly), tomato under cover (whitefly), lettuce in the ground and under cover (whitefly), fruit vegetables (whitefly) **Ornamental plants:** insects with a suction mouth **All plants** (improving the properties of the application liquid)
plant oils/polyethoxylade rapeseed oil	1	**All plants** (synergic additive, used for defoliation)
rapeseed oil	31	**Agriculture crops:** suger beet, rapeseed, corn, sunflower, cereals, potato (improving the properties of the application liquid) **Vegetable crops:** aubergine, pepino (mites, aphids, whitefly), broccoli (aphids, whitefly), rutabaga (aphids, whitefly), Brussel sprouts (aphids, whitefly), onion (aphids), cebula dymka (aphids), zuccinia (mites, whitefly,aphids), garlic (aphids), pumpkin in the ground and under cover (mites, aphids, whitefly), common bean (mites, aphids, whitefly), fennel (aphids), vegetable crops (mites, aphids except cabbage aphid, whitefly, physical activity), pea (aphids), blackberry and tayberry (aphids, scale insects), cauliflower (aphids, whitefly), kohlrabi (aphids, whitefly), common cabbage (aphids, whitefly), Chinese cabbage, pak choi (aphids, whitefly), sprouts (whitefly), carrot (aphids), cucumber in the ground and under cover (mites, aphids, whitefly), pepper in the ground and under cover (mites, aphids, whitefly), root parsley in the ground and under cover (aphids), tomato in the ground and under cover (mites, aphids, whitefly), leek (aphids), lamb's lettuce in the ground and under cover (aphids, whitefly), radish in the ground and under cover (aphids), lettuce in the ground and under cover (aphids, whitefly), celeriac (mites, aphids), celery in the ground and under cover (mites, aphids), salsify/black salify (aphids), eshalot (aphids), asparagus in the ground and under cover (aphids), spinach in the ground and under cover (aphids), chervil in the ground and under cover (aphids), onion vegetables (whitefly), cabbage vegetables (cabbage aphid, whitefly), root and tubers vegetables (whitefly), leaf vegetables (whitefly), fruit vegetables (whitefly), legume vegetables (whitefly) **Fruit trees and shrubs:** gooseberry in the ground and under cover (mites, scale insects, aphids), black and highbush blueberry in the ground and under (mites, scale insects, aphids), peach, nectarine (mites, aphids), fruit trees (physical activity, improvement of application liquid properties, improvement of efficacy), pear (mites, scale insects, aphids),

		apple (mites, scale insects, aphids), blackberry in the ground and under cover and tayberry (scale insects, aphids), raspberry (mites, scale insects, aphids), berries (Eriophyoidea), stone fruits (Eriophyoidea, mites, aphids), pome fruits (Eriophyoidea, aphids, mites), white, red and black current in the ground and under cover (mites, scale insects, aphids), plum (mites, scale insects, aphids), grape (*Calepitrimerus vitis*, mites), sour cherry and sweet cherry (black cherry aphid, cherry blackfly, mites), cranberry (mites, aphids, scale insects) **Ornamental plants:** ornamental trees and shrubs (physical activity, improvement of application liquid properties, improvement of efficacy, aphids, different pests, scale insects, mites), flower and ornamental plants (whitefly, aphids, scale insects, mites, leafhoppers), conifers (*Liosomaphis abietinum*), balcony and home plants (mites, insects with a suction mouth, scale insects, whitefly, physical activity), ornamental plants (Eriophyoidea, mites, insects with a suction mouth, scale insects, whitefly, aphids), roses (whitefly, mites, aphids, scale insects) **All plants** (improving the properties of the application liquid)
esterified rapeseed oil	1	**Agriculture crops:** barley spring, barley winter, rye spring, rye winter, triticale spring, triticale winter, wheat spring, wheat winter, orkisz, corn, sugar beet, fodder beet (herbicidal activity)
sunflower oil	1	**Agriculture crops**: field crops (plant care) **Vegetable crops**: herbs, medicinal plants, vegetables (plant care) **Fruit trees and shrubs:** before the beginning of vegetation of pome fruits, berries, before the beginning of vegetation of nuts, stone fruits (plants care) **Ornamental plants**: plants care
soybean oil	1	**Agriculture crops:** cereal seeds (improvement of seed quality)
Mixture of substances		
azadirachtin, rapeseed oil	1	**Ornamental plants:** balcony and home plants (red spider mite, whitefly, aphids, scale insects, thrips), ornamental plants under cover (red spider mite, whitefly, scale insects, thrips)
linseed oil, *Pongamia pinnata* oil	1	**Ornamental plants:** improvement of plants appearance
rapeseed oil, lecithin	2	**Vegetable crops:** cucumber, tomato, cucumber vegetables (improvement of plants health, physical activity) **Fruit trees and shrubs:** goseberry, current, grape (improvement of plants health, physical activity) **Ornamental plants**: ornamental plants, roses (improvement of plants health, physical activity)
pyrethrins, rapeseed oil	40	**Agriculture crops**: potato and groceries (Colorado potato beetle, beetles: larvaes i adults) **Vegetable crops**: aubergine, pepino (mites, aphids, whitefly, thrips, red spider mite), bazil in the ground and under cover (red spider mite, aphids, thrips), red beet in the ground and under cover (aphids, thrips), onion (aphids, thrips), garlic (aphids, thrips), pumpkin (mites, aphids, whitefly, thrips, red spider mite), tarragon in the ground and under cover (red spider mite, aphids, thrips), bean in the ground and under cover (mites, aphids, whitefly, thrips, red spider mite), fennel in the ground and under cover (red spider mite, aphids, thrips), vegetable plants (insects with biting and sucking mouth), pea (aphids, thrips), kohlrabi (aphids, insects with a suction mouth), caraway in the ground and under cover (red spider mite, aphids, thrips), coriander in the ground and under cover (red spider mite, aphids, thrips), garden dill in the ground and under cove (red spider mite, aphids, thrips), garden lovage in the ground and under cover (red spider mite, aphids, thrips), carrot (aphids), common balm in the ground and under cover (red spider mite, aphids, thrips), mint in the ground and under cover (red spider mite, aphids, thrips), common borage in the ground and under cover (red spider mite, aphids, thrips), cucumber and tomato (insects with a suction mouth, mites, aphids, whitefly, thrips, red spider mite), oregano in the ground and under cover (red spider mite, aphids, thrips), pepper in the ground and under cover (mites, aphids, whitefly, thrips, red spider mite), common pasnip (aphids), root parsley in the ground and under cover (red spider mite, aphids, thrips), leek (insects with a suction mouth, aphids, thrips), purslane in the ground and under cover (aphids), rhubarb in the ground and under cover (aphids), rosemary in the ground and under cover (red spider mite, aphids, thrips), lettuce in the ground and under cover (aphids), celeriac (mites, aphids, thrips, red spider mite), celery in the ground and under cover (mites, aphids, thrips, red spider mite), black salsify (aphids), sage in the ground and under cover (red spider mite, aphids, thrips), common sorrel in the ground and under cover (aphids), chive in the ground and under cover (red spider mite, aphids, thrips), asparagus (insect bites, aphids), spinach and similar (insects with biting and sucking mouth, aphids), fresh herbs and salat vegetables (insects biting except *Tortricidae*, insects with a suction mouth), topinambur (aphids), garden chervil in the ground and under cover (red spider mite, aphids, thrips), thyme in the ground and under cover (red spider mite, aphids, thrips), onion vegetables (insects with a suction mouth), cabbage vegetables (insects with biting and sucking mouth), root and tuberous vegetables (insects with a suction mouth), fruit vegetables (insects with a suction mouth, mites), legume vegetables (mites, insects with biting and sucking mouth), laurel in the ground and under cover (red spider mite, aphids, thrips)

		Fruit trees and shrubs: apple (apple blossom weevil, aphids), berries (aphids), pome fruits (aphids except rosy apple aphid, *Anthonomus piri*, *Caenorhinus aequatus*, caterpillar except *Adoxophyes* spp., codling moth), current (aphids, Tenthredinidae, caterpillar except currant clearwing), plum (insects with a suction mouth, caterpillar except tortricid plum moth), strawberry in the ground and under cover (red spider mite, aphids, whitefly, thrips), sour cherry and sweet cherry (insects with biting and sucking mouth) **Ornamental plants**: balcony and home plants (red spider mite, insects with a suction mouth, whitefly, Woolly Apple Aphid, scale insects), ornamental plants in the ground and under cover (red spider mite, whitefly, insects with a suction mouth, thrips, scale insects, mealybugs, insect bites, scale insects, aphids, red spider mite)

Source: own work / Źródło: opracowanie własne

Table 3. Number of products containing plant oils to protect individual crop groups in the European Union
Tab. 3. Liczba produktów zawierających oleje roślinne do ochrony poszczególnych grup roślin uprawnych w Unii Europejskiej

Crops	Total number of approved products containing plant oils							
	Belgium	Czech Republic	France	Luxemburg	Germany	Slovakia	Hungary	Italy
Agriculture crops	4	4	1	2	11	2	1	1
Vegetable plants	6	6	-	9	48	3	2	-
Fruit trees and shrubs	4	7	2	9	46	3	2	1
Ornamental plants	5	13	2	10	48	3	2	-

Source: own work / Źródło: opracowanie własne

This analysis allowed for the conclusion that products qualified for the protection of organic farming in the European Union contain very diverse plant oils. Most products contain rapeseed oil, mint oil and orange oil. There are also a few registered products containing plant oil as well as another active substance, e.g. azadirachtin + rapeseed oil (1 product), linseed oil + *Pongamia pinnata* oil (1 product), rapeseed oil + lecithin (2 products), pyrethrins + rapeseed oil (40 products).

From the perspective of the entire European Union, protection of wide range of crop species is possible. However, you may notice clear differences in the availability of products containing plant oils in different Member States. Those differences do not always reflect the area under organic production. The Czech Republic is ranked 9th in the European Union as regards the surface acreage of organic farming, it has however 14 registered products containing plant oils. Luxemburg is ranked 26th in the European Union as regards the surface acreage of organic farming, it has however 14 registered products containing plant oils. Luxemburg is ranked 26th in the European Union when it comes to the surface acreage of organic farming and has 11 registered products containing plant oils. On the basis of the analysis of labels of the plant protection products approved for use in organic farming (the material is very comprehensive and is not presented in the tables) the following observations can be formulated in summarizing the availability of plant protection products in the Member States:

In terms of availability of products containing plant oils, the most favourable situation is in Germany, the Czech Republic and Luxemburg. In Germany, the range of registrations of various products recommended for use in organic farming covers all the major agricultural, vegetable, fruit and ornamental species. In the Czech Republic and Luxemburg there are fewer products containing plant oils, but their labels have a vast scope of use (agricultural species, vegetable species, fruit trees, ornamental plants); thanks to which, protection of the majority of crop species is possible. No products containing plant oils are approved for use in organic farming in Croatia, Lithuania, Poland and United Kingdom.

Gaps in the availability of plant protection products that can be used in organic agriculture are a problem for farmers, as these conditions hinder ecological agricultural production and competition in the common market with farmers from other Member States.

4. Conclusions

1. It can be noticed that there are significant differences in the availability of products containing plant oils in different Member States. The biggest number of these products to protect organic crops is approved in Germany, the Czech Republic and Luxemburg. Less in Hungary and Italy. Germany has the broadest protection capacity for each group of organic farming: agricultural, vegetable, fruit and ornamental. No products containing plant oils are approved for use in organic farming in Croatia, Lithuania, Poland and United Kingdom.
2. The number of available products containing plant oils is not connected with the area of land under organic production.
3. Products qualified for the protection of organic farming in the European Union contain different plant oils. The most often used in protection are: rapeseed oil, mint oil and orange oil. There are also registered formulations containing plant oils in mixture with another active substance.
4. Pinole and rapeseed oil have the broadest protection capacity for each group of organic farming: agricultural, vegetable, fruit and ornamental.
5. Differences in the availability of products among the Member States hinder equal competition on the common market.

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