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(54) Title: COMPOSITION AND METHOD FOR TREATING PLANTS WITH EXOGENOUS CHEMICALS

(57) Abstract

Methods and compositions are disclosed wherein exogenous chemicals are applied to plants to generate a desired biological response. One embodiment of the present invention is a plant treatment composition that comprises (a) an exogenous chemical and (b) an alkylether surfactant or mixture of such surfactants having the formula R^{12}–O–$(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m$–$R^{13}$ wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl. The alkylether surfactant or mixture thereof is present in an amount such that the weight/weight ratio of said alkylether surfactant or mixture of such surfactants to the exogenous chemical is about 1:3 to about 1:100.

COMPOSITION AND METHOD FOR TREATING PLANTS WITH EXOGENOUS CHEMICALS

BACKGROUND OF THE INVENTION

This invention relates to formulations and methods for enhancing the efficacy of exogenous chemicals used in treating plants. An exogenous chemical, as defined herein, is any chemical substance, whether naturally or synthetically derived, which (a) has biological activity or is capable of releasing in a plant an ion, moiety or derivative which has biological activity, and (b) is applied to a plant with the intent or result that the chemical substance or its biologically active ion, moiety or derivative enter living cells or tissues of the plant and elicit a stimulatory, inhibitory, regulatory, therapeutic, toxic or lethal response in the plant itself or in a pathogen, parasite or feeding organism present in or on the plant. Examples of exogenous chemical substances include, but are not limited to, chemical pesticides (such as herbicides, algicides, fungicides, bactericides, viricides, insecticides, aphicides, miticides, nematicides, molluscicides, and the like), plant growth regulators, fertilizers and nutrients, gametocides, defoliants, desiccants, mixtures thereof, and the like.

Exogenous chemicals, including foliar-applied herbicides, have at times been formulated with surfactants, so that when water is added, the resulting sprayable composition is more easily and effectively retained on the foliage (e.g., the leaves or other photosynthesizing organs) of plants. Surfactants can also bring other benefits, including improved contact of spray droplets with a waxy leaf surface and, in some cases, improved penetration of the accompanying exogenous chemical into the interior of leaves. Through these and perhaps other effects, surfactants have long been known to increase the biological effectiveness of herbicide compositions, or other compositions of exogenous chemicals, when added to or included in such compositions. Thus, for example, the herbicide glyphosate (N-phosphonomethylglycine) has been formulated with surfactants such as polyoxyalkylene-type surfactants including, among other surfactants, polyoxyalkylene alkylamines. Commercial formulations of glyphosate herbicide marketed under the trademark ROUNDUP® have been formulated with a surfactant composition based on such a polyoxyalkylene alkylamine, in particular a polyethoxylated tallowamine, this surfactant composition being identified as MON 0818. Surfactants have generally been combined with glyphosate or other exogenous chemicals either in a commercial concentrate (herein referred to as a "coformulation"), or in a diluted mixture that is prepared from separate compositions, one comprising an exogenous chemical (e.g. glyphosate) and another comprising surfactant, prior to use in the field (i.e., a tank mix).

Various combinations of exogenous chemicals and surfactants or other adjuvants have been tested in the past. In some instances, the addition of a particular surfactant has not produced uniformly positive or negative changes in the effect of the exogenous chemical on the plant (e.g., a surfactant that

may enhance the activity of a particular herbicide on certain weeds may interfere with, or antagonize, the herbicidal efficacy on another weed species).

Some surfactants tend to degrade fairly rapidly in aqueous solutions. As a result, surfactants that exhibit this property can only be used effectively in tank mixes (i.e., mixed with the other ingredients in solution or dispersion in the tank soon before spraying is to occur), rather than being coformulated in an aqueous composition with the other ingredients in the first instance. This lack of stability, or inadequate shelf-life, has hindered the use of certain surfactants in some exogenous chemical formulations.

Other surfactants, though chemically stable, are physically incompatible with certain exogenous chemicals, particularly in concentrate coformulations. For example, most classes of nonionic surfactant, including polyoxyethylene alkylether surfactants, do not tolerate solutions of high ionic strength, as for example in a concentrated aqueous solution of a salt of glyphosate. Physical incompatibility can also lead to inadequate shelf-life. Other problems that can arise from such incompatibility include the formation of aggregates large enough to interfere with commercial handling and application, for example by blocking spray nozzles.

Another problem that has been observed in the past is the effect of environmental conditions on uptake of an exogenous chemical composition into foliage of a plant. For example, conditions such as temperature, relative humidity, presence or absence of sunlight, and health of the plant to be treated, can affect the uptake of a herbicide into the plant. As a result, spraying exactly the same herbicidal composition in two different situations can result in different herbicidal control of the sprayed plants.

One consequence of the above-described variability is that often a higher rate of herbicide per unit area is applied than might actually be required in that situation, in order to be certain that adequate control of undesired plants will be achieved. For similar reasons, other foliar-applied exogenous chemicals are also typically applied at significantly higher rates than needed to give the desired biological effect in the particular situation where they are used, to allow for the natural variability that exists in efficiency of foliar uptake. A need therefore exists for compositions of exogenous chemicals that, through more efficient uptake into plant foliage, allow reduced use rates.

Many exogenous chemicals are commercially packaged as a liquid concentrate that contains a significant amount of water. The packaged concentrate is shipped to distributors or retailers. Ultimately the packaged concentrate ends up in the hands of an end user, who further dilutes the concentrate by adding water in accordance with label instructions on the package. The dilute composition thus prepared is then sprayed on plants.

A significant portion of the cost of such packaged concentrates is the cost of transporting the concentrate from the manufacturing site to the location where the end user purchases it. Any liquid concentrate formulation that contained relatively less water and thus more exogenous chemical would reduce the cost per unit amount of exogenous chemical. However, one important limit on the ability of the manufacturer to increase the loading of the exogenous chemical in the concentrate is the stability of

that formulation. With some combinations of ingredients, a limit will be reached at which any further reduction of water content in the concentrate will cause it to become unstable (e.g., to separate into discrete layers), which may make it commercially unacceptable.

Accordingly, a need exists for improved formulations of exogenous chemicals, particularly herbicides, that are stable, effective, less sensitive to environmental conditions, and permit the use of reduced amounts of exogenous chemical to achieve the desired biological effect in or on plants. A need also exists for stable liquid concentrate formulations of exogenous chemicals that contain less water and more exogenous chemical than prior art concentrates.

SUMMARY OF THE INVENTION

The present invention relates to novel methods and compositions wherein exogenous chemicals are applied to plants to generate a desired biological response.

One embodiment of the present invention is a plant treatment composition that comprises (a) an exogenous chemical and (b) an alkylether surfactant or mixture of such surfactants having the formula

$$R^{12}\text{-O-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13} \qquad \text{VI}$$

wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl. The alkylether surfactant or mixture thereof is present in an amount such that the weight/weight ratio of said alkylether surfactant or mixture of such surfactants to the exogenous chemical is about 1:3 to about 1:100. The term "alkylether" as used herein should be understood to include alkenylether surfactants. Preferably R^{12} is a saturated straight-chain alkyl group, R^{13} is hydrogen, m is 0 and n is from about 10 to about 40, more preferably from about 20 to about 40. Most preferably the alkylether surfactant is a polyoxyethylene cetyl or stearyl ether or mixture thereof having 20-40 moles of ethylene oxide (EO).

In one embodiment, the composition is an aqueous concentrate further comprising water and an amount of a solid inorganic particulate colloidal material effective to stabilize the composition, said composition not exhibiting phase separation over a period of time T as defined below when stored in a closed container at a temperature in the range from about 15°C to about 30°C; wherein the exogenous chemical and the surfactant are present at concentrations in the absolute or relative to each other such that, in the absence of the colloidal material, phase separation would occur during said period of time T.

The period of time T over which a composition can be observed to determine if phase separation occurs is in the range from about 1 hour to about 60 days. "Phase separation" in the present context means separation of at least part of the surfactant component from other ingredients of the composition as a distinct phase. The particulate colloidal material preferably is present in an amount between about 0.01% and about 5% by weight, more preferably between about 0.5% and about 2.5% by weight, of the composition. By "aqueous concentrate" is meant a composition comprising water and from about 10% to about 60% by weight of the exogenous chemical.

Examples of suitable solid particulate colloidal materials include inorganic oxides such as silicon oxides, aluminum oxides, titanium oxides, and mixtures thereof. Preferably the particulate colloidal material has an average specific surface area of about 50 to about 400 m^2/g, more preferably about 180 to about 400 m^2/g. In one particular embodiment, the particulate colloidal material has a bimodal distribution of specific surface area whereby a first component of the colloidal material has an average specific surface area of about 50 to about 150 m^2/g and a second component of the colloidal material has an average specific surface area of about 180 to about 400 m^2/g.

In another embodiment of the invention, compositions are provided comprising (a) an exogenous chemical, (b) an alkylether surfactant or mixture of such surfactants having the formula shown above, and (c) a compound of formula

R^{14}-CO-A-R^{1} VII

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH. R^{14} preferably has about 11 to about 21 carbon atoms, R^{15} preferably has 1 to about 6 carbon atoms and A is preferably O. The aqueous composition in embodiments comprising a compound of formula VII preferably is an emulsion comprising an oil phase that comprises said second excipient substance, for example a water-in-oil-in-water multiple emulsion or an oil-in-water emulsion.

A composition comprising a compound of formula VII can, if desired or necessary, further comprise an amount of solid inorganic particulate colloidal material effective to stabilize the composition, exactly as defined above.

In certain preferred embodiments of the present invention, the compound (c) is a C_{1-4} alkyl ester of a C_{12-18} fatty acid, more preferably a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid. Propyl, isopropyl or butyl esters of C_{12-18} fatty acids, such as butyl stearate, are especially preferred.

A wide variety of exogenous chemicals can be used in the compositions and methods of the present invention. A preferred class is foliar-applied exogenous chemicals, i.e. exogenous chemicals that are normally applied post-emergence to foliage of plants. A preferred subclass of foliar-applied exogenous chemicals is those that are water-soluble. By "water-soluble" in this context is meant having a solubility in distilled water at 25°C greater than about 1% by weight. Especially preferred water-soluble exogenous chemicals are salts that have an anion portion and a cation portion. In one embodiment of the invention, at least one of the anion and cation portions is biologically active and has a molecular weight of less than about 300. Particular examples of such exogenous chemicals where the cation portion is biologically active are paraquat, diquat and chlormequat. More commonly it is the anion portion that is biologically active.

Another preferred subclass of exogenous chemicals is those that exhibit systemic biological activity in the plant. Within this subclass, an especially preferred group of exogenous chemicals is N-phosphonomethylglycine and its herbicidal derivatives. N-phosphonomethylglycine, often referred to by

its common name glyphosate, can be used in its acid form, but is more preferably used in the form of a salt. Any water-soluble salt of glyphosate can be used in the practice of this invention. Some preferred salts include the sodium, potassium, ammonium, mono-, di-, tri- and tetra-C_{1-4}-alkylammonium, mono-, di- and tri-C_{1-4}-alkanolammonium, mono-, di- and tri-C_{1-4}-alkylsulfonium and sulfoxonium salts. The ammonium, monoisopropylammonium and trimethylsulfonium salts of glyphosate are especially preferred. Mixtures of salts can also be useful in certain situations.

Compositions of the present invention can be used in methods of treating plants. Foliage of a plant is contacted with a biologically effective amount of the composition. "Contacting" in this context means placing the composition on the foliage.

A composition of the present invention comprising an exogenous chemical and an alkylether surfactant as described above can have a number of different physical forms. For example, the composition can further comprise water in an amount effective to make the composition a dilute aqueous composition ready for application to foliage of a plant. Such a composition typically contains about 0.02 to about 2 percent by weight of the exogenous chemical, but for some purposes can contain up to about 10 percent by weight or even more of the exogenous chemical.

Alternatively, the composition can be a shelf-stable concentrate composition comprising the exogenous chemical substance in an amount of about 10 to about 90 percent by weight. Such shelf-stable concentrates can be, for example, (1) a solid composition comprising the exogenous chemical substance in an amount of about 30 to about 90 percent by weight, such as a water-soluble or water-dispersible granular formulation, or (2) a composition that further comprises a liquid diluent, wherein the composition comprises the exogenous chemical substance in an amount of about 10 to about 60 percent by weight. In this latter embodiment, it is especially preferred for the exogenous chemical substance to be water-soluble and present in an aqueous phase of the composition in an amount of about 15 to about 45 percent by weight of the composition. In particular, such a composition can be, for example, an aqueous solution concentrate or an emulsion having an oil phase. If it is an emulsion, it can more specifically be, for example, an oil-in-water emulsion, a water-in-oil emulsion, or a water-in-oil-in-water multiple emulsion. When a compound (c) such as butyl stearate is included in an emulsion composition, it is predominantly present in the oil phase.

As described above, one embodiment of the invention is a sprayable composition that comprises an exogenous chemical, an aqueous diluent, and an alkylether surfactant.. The term "spray composition" is sometimes used herein to mean a sprayable composition.

In a related embodiment of the invention, a concentrate composition is provided which, upon dilution, dispersion or dissolution in water forms the sprayable composition just described. The concentrate composition contains a reduced amount of the aqueous diluent, or, in a particular embodiment, is a dry composition having less than about 5% water by weight. Typically a concentrate composition of the invention contains at least about 10% by weight of the exogenous chemical,

preferably at least about 15%.

The compositions and methods of the present invention have a number of advantages. They provide enhanced biological activity of exogenous chemicals in or on plants in comparison with prior formulations, either in terms of greater ultimate biological effect, or obtaining an equivalent biological effect while using a reduced application rate of exogenous chemical. Certain herbicide formulations of the present invention can avoid antagonism that has been observed in some prior art herbicide formulations, and can minimize quick production of necrotic lesions on leaves that in some situations hinder overall translocation of herbicide in the plant. Certain herbicide compositions of the invention modify the spectrum of activity of the herbicide across a range of plant species. For example, certain formulations of the present invention containing glyphosate can provide good herbicidal activity against broadleaf weeds while not losing any herbicidal effectiveness on narrowleaf weeds. Others can enhance herbicidal effectiveness on narrowleaf weeds to a greater extent than on broadleaf weeds. Still others can have enhanced effectiveness which is specific to a narrow range of species or even a single species.

Another advantage of the present invention is that it employs relatively small amounts of the alkylether surfactant in relation to the amount of exogenous chemical employed. This makes the compositions and methods of the present invention relatively inexpensive, and also tends to reduce instability problems in specific compositions where the alkylether surfactant is physically incompatible with the exogenous chemical (e.g., in solutions of high ionic strength, such as concentrated glyphosate salt solutions).

Even at the low concentrations of the excipient substances used in the present invention, there may be limits on the maximum concentration of exogenous chemical that can be used without causing compatibility problems (e.g., separation of the composition into discrete layers). In some preferred embodiments of the invention, composition stability at high loadings of exogenous chemical is maintained by adding other ingredients such as, for example, colloidal particulates. Some compositions of the present invention exhibit enhanced biological activity and have a higher loading of exogenous chemical than possible in prior art compositions.

Further, compositions of the present invention are less sensitive in some instances to environmental conditions such as relative humidity at the time of application to the plant. Also, the present invention allows the use of smaller amounts of herbicides or other pesticides, while still obtaining the required degree of control of weeds or other undesired organisms.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Examples of exogenous chemical substances that can be included in compositions of the present invention include, but are not limited to, chemical pesticides (such as herbicides, algicides, fungicides, bactericides, viricides, insecticides, aphicides, miticides, nematicides, molluscicides and the like), plant growth regulators, fertilizers and nutrients, gametocides, defoliants, desiccants, mixtures thereof and the like. In one embodiment of the invention, the exogenous chemical is polar.

A preferred group of exogenous chemicals are those that are normally applied post-emergence to the foliage of plants, i.e. foliar-applied exogenous chemicals.

Some exogenous chemicals useful in the present invention are water-soluble, for example salts that comprise biologically active ions, and also comprise counterions, which may be biologically inert or relatively inactive. A particularly preferred group of these water-soluble exogenous chemicals or their biologically active ions or moieties are systemic in plants, that is, they are to some extent translocated from the point of entry in the foliage to other parts of the plant where they can exert their desired biological effect. Especially preferred among these are herbicides, plant growth regulators and nematicides, particularly those that have a molecular weight, excluding counterions, of less than about 300. More especially preferred among these are exogenous chemical compounds having one or more functional groups selected from amine, carboxylate, phosphonate and phosphinate groups.

Among such compounds, an even more preferred group are herbicidal or plant growth regulating exogenous chemical compounds having at least one of each of amine, carboxylate, and either phosphonate or phosphinate functional groups. Salts of N-phosphonomethylglycine are examples of this group of exogenous chemicals. Further examples include salts of glufosinate, for instance the ammonium salt (ammonium DL-homoalanin-4-yl (methyl) phosphinate).

Another preferred group of exogenous chemicals which can be applied by the method of the invention are nematicides such as those disclosed in U.S. Patent No. 5,389,680, the disclosure of which is incorporated herein by reference. Preferred nematicides of this group are salts of 3,4,4-trifluoro-3-butenoic acid or of N-(3,4,4-trifluoro-1-oxo-3-butenyl)glycine.

Exogenous chemicals which can usefully be applied by the method of the present invention are normally, but not exclusively, those which are expected to have a beneficial effect on the overall growth or yield of desired plants such as crops, or a deleterious or lethal effect on the growth of undesirable plants such as weeds. The method of the present invention is particularly useful for herbicides, especially those that are normally applied post-emergence to the foliage of unwanted vegetation.

Herbicides which can be applied by the method of the present invention include but are not limited to any listed in standard reference works such as the "Herbicide Handbook," Weed Science Society of America, 1994, 7th Edition, or the "Farm Chemicals Handbook," Meister Publishing Company, 1997 Edition. Illustratively these herbicides include acetanilides such as acetochlor, alachlor and metolachlor, aminotriazole, asulam, bentazon, bialaphos, bipyridyls such as paraquat, bromacil, cyclohexenones such as clethodim and sethoxydim, dicamba, diflufenican, dinitroanilines such as pendimethalin, diphenylethers such as acifluorfen, fomesafen and oxyfluorfen, fatty acids such as C_{9-10} fatty acids, fosamine, flupoxam, glufosinate, glyphosate, hydroxybenzonitriles such as bromoxynil, imidazolinones such as imazaquin and imazethapyr, isoxaben, norflurazon, phenoxies such as 2,4-D, phenoxypropionates such as diclofop, fluazifop and quizalofop, picloram, propanil, substituted ureas such as fluometuron and isoproturon, sulfonylureas such as chlorimuron, chlorsulfuron, halosulfuron,

metsulfuron, primisulfuron, sulfometuron and sulfosulfuron, thiocarbamates such as triallate, triazines such as atrazine and metribuzin, and triclopyr. Herbicidally active derivatives of any known herbicide are also within the scope of the present invention. A herbicidally active derivative is any compound which is a minor structural modification, most commonly but not restrictively a salt or ester, of a known herbicide. These compounds retain the essential activity of the parent herbicide, but may not necessarily have a potency equal to that of the parent herbicide. These compounds may convert to the parent herbicide before or after they enter the treated plant. Mixtures or coformulations of a herbicide with other ingredients, or of more than one herbicide, may likewise be employed.

An especially preferred herbicide is N-phosphonomethylglycine (glyphosate), a salt, adduct or ester thereof, or a compound which is converted to glyphosate in plant tissues or which otherwise provides glyphosate ion. Glyphosate salts that can be used according to this invention include but are not restricted to alkali metal, for example sodium and potassium, salts; ammonium salt; alkylamine, for example dimethylamine and isopropylamine, salts; alkanolamine, for example ethanolamine, salts; alkylsulfonium, for example trimethylsulfonium, salts; sulfoxonium salts; and mixtures thereof. The herbicidal compositions sold by Monsanto Company as ROUNDUP® and ACCORD® contain the monoisopropylamine (IPA) salt of N-phosphonomethylglycine. The herbicidal compositions sold by Monsanto Company as ROUNDUP® Dry and RIVAL® contain the monoammonium salt of N-phosphonomethylglycine. The herbicidal composition sold by Monsanto Company as ROUNDUP® Geoforce contains the monosodium salt of N-phosphonomethylglycine. The herbicidal composition sold by Zeneca as TOUCHDOWN® contains the trimethylsulfonium salt of N-phosphonomethylglycine. The herbicidal properties of N-phosphonomethylglycine and its derivatives were first discovered by Franz, then disclosed and patented in U.S. Patent 3,799,758, issued March 26, 1974. A number of herbicidal salts of N-phosphonomethylglycine were patented by Franz in U.S. Patent 4,405,531, issued September 20, 1983. The disclosures of both of these patents are hereby incorporated by reference.

Because the commercially most important herbicidal derivatives of N-phosphonomethylglycine are certain salts thereof, the glyphosate compositions useful in the present invention will be described in more detail with respect to such salts. These salts are well known and include ammonium, IPA, alkali metal (such as the mono-, di-, and trisodium salts, and the mono-, di-, and tripotassium salts), and trimethylsulfonium salts. Salts of N-phosphonomethylglycine are commercially significant in part because they are water soluble. The salts listed immediately above are highly water soluble, thereby allowing for highly concentrated solutions that can be diluted at the site of use. In accordance with the method of this invention as it pertains to glyphosate herbicide, an aqueous solution containing a herbicidally effective amount of glyphosate and other components in accordance with the invention is applied to foliage of plants. Such an aqueous solution can be obtained by dilution of a concentrated glyphosate salt solution with water, or dissolution or dispersion in water of a dry (e.g. granular, powder, tablet or briquette) glyphosate formulation.

Exogenous chemicals should be applied to plants at a rate sufficient to give the desired biological effect. These application rates are usually expressed as amount of exogenous chemical per unit area treated, e.g. grams per hectare (g/ha). What constitutes a "desired effect" varies according to the standards and practice of those who investigate, develop, market and use a specific class of exogenous chemicals. For example, in the case of a herbicide, the amount applied per unit area to give 85% control of a plant species as measured by growth reduction or mortality is often used to define a commercially effective rate.

Herbicidal effectiveness is one of the biological effects that can be enhanced through this invention. "Herbicidal effectiveness," as used herein, refers to any observable measure of control of plant growth, which can include one or more of the actions of (1) killing, (2) inhibiting growth, reproduction or proliferation, and (3) removing, destroying, or otherwise diminishing the occurrence and activity of plants.

The herbicidal effectiveness data set forth herein report "inhibition" as a percentage following a standard procedure in the art which reflects a visual assessment of plant mortality and growth reduction by comparison with untreated plants, made by technicians specially trained to make and record such observations. In all cases, a single technician makes all assessments of percent inhibition within any one experiment or trial. Such measurements are relied upon and regularly reported by Monsanto Company in the course of its herbicide business.

The selection of application rates that are biologically effective for a specific exogenous chemical is within the skill of the ordinary agricultural scientist. Those of skill in the art will likewise recognize that individual plant conditions, weather and growing conditions, as well as the specific exogenous chemical and formulation thereof selected, will affect the efficacy achieved in practicing this invention. Useful application rates for exogenous chemicals employed can depend upon all of the above conditions. With respect to the use of the method of this invention for glyphosate herbicide, much information is known about appropriate application rates. Over two decades of glyphosate use and published studies relating to such use have provided abundant information from which a weed control practitioner can select glyphosate application rates that are herbicidally effective on particular species at particular growth stages in particular environmental conditions.

Herbicidal compositions of glyphosate or derivatives thereof are used to control a very wide variety of plants worldwide. Such compositions can be applied to a plant in a herbicidally effective amount, and can effectively control one or more plant species of one or more of the following genera without restriction: Abutilon, Amaranthus, Artemisia, Asclepias, Avena, Axonopus, Borreria, Brachiaria, Brassica, Bromus, Chenopodium, Cirsium, Commelina, Convolvulus, Cynodon, Cyperus, Digitaria, Echinochloa, Eleusine, Elymus, Equisetum, Erodium, Helianthus, Imperata, Ipomoea, Kochia, Lolium, Malva, Oryza, Ottochloa, Panicum, Paspalum, Phalaris, Phragmites, Polygonum, Portulaca, Pteridium, Pueraria, Rubus, Salsola, Setaria, Sida, Sinapis, Sorghum, Triticum, Typha, Ulex, Xanthium, and Zea.

Particularly important species for which glyphosate compositions are used are exemplified without limitation by the following:

Annual broadleaves:

velvetleaf (Abutilon theophrasti)

pigweed (Amaranthus spp.)

buttonweed (Borreria spp.)

oilseed rape, canola, indian mustard, etc. (Brassica spp.)

commelina (Commelina spp.)

filaree (Erodium spp.)

sunflower (Helianthus spp.)

morningglory (Ipomoea spp.)

kochia (Kochia scoparia)

mallow (Malva spp.)

wild buckwheat, smartweed, etc. (Polygonum spp.)

purslane (Portulaca spp.)

russian thistle (Salsola spp.)

sida (Sida spp.)

wild mustard (Sinapis arvensis)

cocklebur (Xanthium spp.)

Annual narrowleaves:

wild oat (Avena fatua)

carpetgrass (Axonopus spp.)

downy brome (Bromus tectorum)

crabgrass (Digitaria spp.)

barnyardgrass (Echinochloa crus-galli)

goosegrass (Eleusine indica)

annual ryegrass (Lolium multiflorum)

rice (Oryza sativa)

ottochloa (Ottochloa nodosa)

bahiagrass (Paspalum notatum)

canarygrass (Phalaris spp.)

foxtail (Setaria spp.)

wheat (Triticum aestivum)

corn (Zea mays)

Perennial broadleaves:
mugwort (Artemisia spp.)
milkweed (Asclepias spp.)
canada thistle (Cirsium arvense)
field bindweed (Convolvulus arvensis)
kudzu (Pueraria spp.)

Perennial narrowleaves:
brachiaria (Brachiaria spp.)
bermudagrass (Cynodon dactylon)
yellow nutsedge (Cyperus esculentus)
purple nutsedge (C. rotundus)
quackgrass (Elymus repens)
lalang (Imperata cylindrica)
perennial ryegrass (Lolium perenne)
guineagrass (Panicum maximum)
dallisgrass (Paspalum dilatatum)
reed (Phragmites spp.)
johnsongrass (Sorghum halepense)
cattail (Typha spp.)

Other perennials:
horsetail (Equisetum spp.)
bracken (Pteridium aquilinum)
blackberry (Rubus spp.)
gorse (Ulex europaeus)

Thus, the method of the present invention, as it pertains to glyphosate herbicide, can be useful on any of the above species.

Effectiveness in greenhouse tests, usually at exogenous chemical rates lower than those normally effective in the field, is a proven indicator of consistency of field performance at normal use rates. However, even the most promising composition sometimes fails to exhibit enhanced performance in individual greenhouse tests. As illustrated in the Examples herein, a pattern of enhancement emerges over a series of greenhouse tests; when such a pattern is identified this is strong evidence of biological enhancement that will be useful in the field.

Compositions of the present invention include one or more long-chain alkylether surfactants

having the formula VI above. R^{12} can be branched or unbranched, saturated or unsaturated. R^{12} is preferably straight chain saturated C_{16} alkyl (cetyl) or straight chain saturated C_{18} alkyl (stearyl). In preferred alkylethers m is 0, n is an average number from about 20 to about 40 and R^{13} is preferably hydrogen. Among especially preferred alkylether surfactants are those identified in the International Cosmetic Ingredient Directory as ceteth-20, ceteareth-20, ceteareth-27, steareth-20 and steareth-30.

Aqueous concentrate compositions in some circumstances are limited in the degree to which an exogenous chemical such as glyphosate can be loaded. At some point, as the loading of exogenous chemical is increased, the composition will not remain suitably stable. Addition of a small amount of colloidal particulate to such compositions has surprisingly been found to greatly increase loading ability while retaining desired stability. Inclusion of such colloidal particulates can also enhance biological activity of an exogenous chemical formulation. Oxides of silicon, aluminum and titanium are preferred colloidal particulate materials. Particle size is preferably such that specific surface area is in the range from about 50 to about 400 m^2/g. Where the exogenous chemical is glyphosate, the use of colloidal particulate enables glyphosate acid equivalent loadings of at least 30% by weight for compositions containing sufficient alkylether and fatty acid ester to show enhanced herbicidal effectiveness, or at least 40% by weight for compositions containing alkylether but no fatty acid ester, and showing herbicidal effectiveness at least equal to current commercial products loaded at about 30% by weight. We have found especially useful improvement in storage stability can be obtained using colloidal particulates having specific surface area between about 180 and about 400 m^2/g.

Other means of improving stability of highly loaded compositions may also be possible and are within the scope of the present invention.

Compositions in accordance with the present invention are typically prepared by combining water, the exogenous chemical, the alkylether surfactant, and other ingredients such as colloidal particulates and/or fatty acid esters if such ingredients are to be used. Details of specific processes used to prepare such compositions are included in the Examples herein.

The concentrations of the various components will vary, in part depending on whether a concentrate is being prepared that will be further diluted before spraying onto a plant, or whether a solution or dispersion is being prepared that can be sprayed without further dilution.

In an aqueous glyphosate formulation that includes a C_{16-18} alkylether surfactant and butyl stearate, suitable concentrations can be: glyphosate 0.1 - 400 g a.e./l, alkylether surfactant 0.001 - 10% by weight, and butyl stearate 0.001 - 10% by weight. To achieve the higher concentrations in these ranges, it is often beneficial to add other ingredients to provide acceptable storage stability, for example colloidal particulate silica or aluminum oxide at 0.5 - 2.5% by weight. In an aqueous glyphosate formulation that includes a C_{16-18} alkylether surfactant but no butyl stearate, glyphosate concentration can suitably be increased to 500 g a.e./l or more, in the presence of a colloidal particulate at 0.5 - 2.5% by weight.

In solid glyphosate formulations, higher concentrations of ingredients are possible because of the elimination of most of the water.

Although various compositions of the present invention are described herein as comprising certain listed materials, in some preferred embodiments of the invention the compositions consist essentially of the indicated materials.

Optionally, other agriculturally acceptable materials can be included in the compositions. For example, more than one exogenous chemical can be included. Also, various agriculturally acceptable adjuvants can be included, whether or not their purpose is to directly contribute to the effect of the exogenous chemical on a plant. For example, when the exogenous chemical is a herbicide, liquid nitrogen fertilizer or ammonium sulfate might be included in the composition. As another example, stabilizers can be added to the composition. In some instances it might be desirable to include microencapsulated acid in the composition, to lower the pH of a spray solution on contact with a leaf. One or more surfactants can also be included. Surfactants mentioned here by trade name, and other surfactants that can be useful in the method of the invention, are indexed in standard reference works such as McCutcheon's Emulsifiers and Detergents, 1997 edition, Handbook of Industrial Surfactants, 2nd Edition, 1997, published by Gower, and International Cosmetic Ingredient Dictionary, 6th Edition, 1995.

The compositions of the present invention can be applied to plants by spraying, using any conventional means for spraying liquids, such as spray nozzles, atomizers, or the like. Compositions of the present invention can be used in precision farming techniques, in which apparatus is employed to vary the amount of exogenous chemical applied to different parts of a field, depending on variables such as the particular plant species present, soil composition, and the like. In one embodiment of such techniques, a global positioning system operated with the spraying apparatus can be used to apply the desired amount of the composition to different parts of a field.

The composition at the time of application to plants is preferably dilute enough to be readily sprayed using standard agricultural spray equipment. Preferred application rates for the present invention vary depending upon a number of factors, including the type and concentration of active ingredient and the plant species involved. Useful rates for applying an aqueous composition to a field of foliage can range from about 25 to about 1,000 liters per hectare (l/ha) by spray application. The preferred application rates for aqueous solutions are in the range from about 50 to about 300 l/ha.

Many exogenous chemicals (including glyphosate herbicide) must be taken up by living tissues of the plant and translocated within the plant in order to produce the desired biological (e.g., herbicidal) effect. Thus, it is important that a herbicidal composition not be applied in such a manner as to excessively injure and interrupt the normal functioning of the local tissue of the plant so quickly that translocation is reduced. However, some limited degree of local injury can be insignificant, or even beneficial, in its impact on the biological effectiveness of certain exogenous chemicals.

A large number of compositions of the invention are illustrated in the Examples that follow. Many concentrate compositions of glyphosate have provided sufficient herbicidal effectiveness in greenhouse tests to warrant field testing on a wide variety of weed species under a variety of application conditions. Aqueous compositions tested in the field comprising an alkylether surfactant and/or containing a fatty acid ester have included:

Field composition	Glyphosate g a.e./l	% w/w		Type of surfactant	Type of fatty acid ester
		Fatty acid ester	Surfactant		
F-5	163	1.0	10.0	oleth-20	Bu stearate
F-8	163	1.0	10.0	steareth-20	Bu stearate
F-11	163	0.5	5.0	oleth-20	Bu stearate
F-12	163	0.3	5.0	oleth-20	Bu stearate
F-13	163	0.3	2.5	oleth-20	Bu stearate
F-16	163	0.5	5.0	steareth-20	Bu stearate
F-17	163	0.5	5.0	ceteth-20	Bu stearate
F-19	163	0.5	5.0	ceteareth-27	Bu stearate
F-22	163		5.0	steareth-20	
F-23	163		5.0	ceteth-20	
F-24	163		5.0	laureth-23	
F-25	163	0.3	5.0	ceteareth-27	Bu stearate
F-26	163	0.3	2.5	ceteareth-27	Bu stearate
F-27	163		5.0	ceteareth-27	
F-28	163	0.5	5.0	ceteareth-27	Me stearate
F-29	163	0.5	5.0	steareth-20	Me stearate
F-30	163	0.5	5.0	oleth-20	
F-33	163	0.5	5.0	ceteareth-15	Bu stearate
F-34	163		5.0	ceteareth-15	
F-35	163	0.5	5.0	steareth-30	Bu stearate

The above compositions were prepared by process (vii) if they contain fatty acid ester and by process (viii) if they do not. Both processes are described in the Examples.

Aqueous compositions tested in the field containing colloidal particulates have included:

Field composition	Glyphos-ate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surf-actant	Coll. partic.	Other				
F-36	360	1.0	10.0	1.3		steareth-20	Aerosil 380	Bu stearate	
F-37	360	1.0	10.0	1.3		oleth-20	Aerosil 380	Bu stearate	
F-38	360	1.0	10.0	1.3		steareth-30	Aerosil 380	Bu stearate	
F-39	360		10.0	1.3		steareth-30	Aerosil 380		
F-50	360	1.0	10.0	1.3		ceteareth-15	Aerosil 380	Bu stearate	
F-51	360	1.0	10.0	1.3		ceteth-20	Aerosil 380	Bu stearate	
F-52	360	1.0	10.0	1.3		steareth-20	Aerosil 380	Bu stearate	
F-53	360	1.0	10.0	1.3		oleth-20	Aerosil 380	Bu stearate	
F-54	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Bu stearate	
F-55	360	1.0	10.0	1.3		steareth-30	Aerosil 380	Bu stearate	

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surfactant	Coll. partic.	Other				
F-56	360		10.0	1.3		steareth-30	Aerosil 380		
F-57	360		10.0	1.3		ceteareth-27	Aerosil 380		
F-58	360		10.0	1.3		steareth-20	Aerosil 380		
F-59	360		10.0	1.3		oleth-20	Aerosil 380		
F-60	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Me stearate	
F-61	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Me palmitate	
F-62	300		10.0	1.3		ceteareth-27	Aerosil 380		
F-63	240		10.0	1.3		ceteareth-27	Aerosil 380		
F-64	360		6.0	1.3		ceteareth-27	Aerosil 380		
F-65	300		6.0	1.3		ceteareth-27	Aerosil 380		
F-66	240		6.0	1.3		ceteareth-27	Aerosil 380		
F-84	480		3.0	0.8		steareth-20	Aerosil 380		
F-85	480		3.0	1.5		oleth-20	Aerosil 380		
F-86	480		3.0	1.5		oleth-20	Aerosil MOX-170		
F-87	480		3.0	1.5		oleth-20	Aerosil OX-50		
F-89	480		3.0	1.5		steareth-20	Aerosil blend 2		
F-90	480		3.0	1.5		oleth-20	Aerosil blend 2		
F-91	480		4.5	1.5		oleth-20	Aerosil 380		
F-92	480		4.5	1.5		steareth-20	Aerosil 380		
F-93	480		3.0	1.5		steareth-20	Aerosil blend 1		
F-94	480		1.0	1.5		steareth-20	Aerosil blend 1		
F-95	480		6.0	1.5		steareth-20	Aerosil blend 1		
F-96	480		4.5	1.5	0.5	steareth-20	Aerosil blend 2		propylene glycol
F-97	480		6.0	1.5	0.5	steareth-20	Aerosil blend 2		propylene glycol
F-98	480		6.0	1.5	0.5	oleth-20	Aerosil blend 2		propylene glycol
F-99	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-100	480		6.0	1.5		steareth-20	Al oxide C		
F-101	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Al oxide C		propylene glycol
F-102	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Al oxide C		propylene glycol
F-103	480		3.0	1.5		steareth-20	Aerosil 380		
F-104	480		4.5	1.5		steareth-20	Al oxide C		
F-105	480		6.0	1.5		steareth-20	Aerosil 380		

Field composition	Glyphos-ate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surf-actant	Coll. partic.	Other				
F-106	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil 380		propylene glycol
F-107	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil 380		propylene glycol
F-108	480		4.5	1.5		steareth-20	Aerosil blend 2		
F-109	480		6.0	1.5		steareth-20	Aerosil blend 2		
F-110	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-111	480		4.5	1.5		steareth-30	Aerosil blend 2		
F-112	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-113	480		6.0	1.5		steareth-30	Aerosil blend 2		
F-114	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-115	480		10.0	1.5		steareth-20	Aerosil blend 2		
F-116	480		4.5	1.5		ceteareth-27	Aerosil 380		
F-117	480		6.0	1.5		ceteareth-27	Aerosil 380		
F-118	480		4.5	1.5		ceteareth-27	Aerosil blend 2		
F-119	480		6.0	1.5		ceteareth-27	Aerosil blend 2		
F-120	480		4.5	1.5		ceteareth-27	Al oxide C		
F-121	480		6.0	1.5		ceteareth-27	Al oxide C		

Aerosil blend 1: Aerosil MOX-80 + Aerosil MOX-170 (1:1)
Aerosil blend 2: Aerosil MOX-80 + Aerosil 380 (1:2)

The above compositions were prepared by process (ix) as described in the Examples.

Aqueous compositions tested in the field comprising soybean lecithin (45% phospholipid, Avanti), alkylether surfactant and fatty acid ester have included:

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of fatty acid ester
		Lecithin	MON 0818	Fatty acid ester	Surfactant		
F-136	360	6.0	4.5	1.5	3.0 + 4.5	ceteareth-27 + Ethomeen T/25	Bu stearate

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of fatty acid ester
		Lecithin	MON 0818	Fatty acid ester	Surfactant		
F-138	228	0.8		3.8	3.0 + 3.0	ceteareth-27 + Ethomeen T/25	Bu stearate
F-139	228	1.5		1.5	3.0 + 3.0	ceteareth-27 + Ethomeen T/25	Bu stearate

The above compositions were prepared by process (x) as described in the Examples.

Dry compositions tested in the field have included:

Field composition	% w/w					Type of surfactant	Type of colloidal particulate	Other ingredients
	Glyphos-ate a.e.	Butyl stearate	Surfact-ant	Colloidal particulate	Other			
F-156	64		25.0	2.0		steareth-20	Aerosil blend 1	
F-157	68		20.0	2.0		steareth-20	Aerosil blend 1	
F-158	72		15.0	2.0		steareth-20	Aerosil blend 1	
F-159	64		25.0	1.0		ceteth-20	Aerosil 380	
F-160	65		25.0	1.0		steareth-20	Aerosil 380	
F-161	65		25.0	1.0		oleth-20	Aerosil 380	
F-166	68		20.0	2.0		steareth-20	Aerosil blend 1	
F-167	66	2.0	20.0	2.0		steareth-20	Aerosil blend 1	
F-168	68		20.0	2.0		oleth-20	Aerosil blend 1	
F-169	66	2.0	20.0	2.0		oleth-20	Aerosil blend 1	
F-170	66	2.0	20.0	2.0		ceteareth-27	Aerosil blend 1	
F-171	48		14.1		36.1	ceteareth-27		NH_4 phosphate
F-172	65		20.0		5.0	ceteareth-27		Na acetate
F-173	70		20.0			ceteareth-27		

Aerosil blend 1: Aerosil MOX-80 + Aerosil MOX-170 (1:1)

The above compositions were prepared by the process described for dry granular compositions in Example 40.

EXAMPLES

In the following Examples illustrative of the invention, greenhouse tests were conducted to evaluate relative herbicidal effectiveness of glyphosate compositions. Compositions included for comparative purposes included the following:

Formulation B: which consists of 41% by weight of glyphosate IPA salt in aqueous solution. This formulation is sold in the USA by Monsanto Company under the ACCORD® trademark.

Formulation C: which consists of 41% by weight of glyphosate IPA salt in aqueous solution with a coformulant (15% by weight) of a surfactant (MON 0818 of Monsanto Company) based on polyoxyethylene (15) tallowamine. This formulation is sold in Canada by Monsanto Company under the ROUNDUP® trademark.

Formulation J: which consists of 41% by weight of glyphosate IPA salt in aqueous solution,

together with surfactant. This formulation is sold in the USA by Monsanto Company under the ROUNDUP® ULTRA trademark.

Formulation K: which consists of 75% by weight of glyphosate ammonium salt together with surfactant, as a water-soluble dry granular formulation. This formulation is sold in Australia by Monsanto Company under the ROUNDUP® DRY trademark.

Formulations B, C and J contain 356 grams of glyphosate acid equivalent per liter (g a.e./l). Formulation K contains 680 grams of glyphosate acid equivalent per kilogram (g a.e./kg).

Various proprietary excipients were used in compositions of the Examples. They may be identified as follows:

Trade name	Manufacturer	Chemical description
Aerosil 90	Degussa	amorphous silica, 90 m^2/g
Aerosil 380	Degussa	amorphous silica, 380 m^2/g
Aerosil MOX-80	Degussa	amorphous silica/aluminum oxide, 80 m^2/g
Aerosil MOX-170	Degussa	amorphous silica/aluminum oxide, 170 m^2/g
Aerosil OX-50	Degussa	amorphous silica, 50 m^2/g
Agrimul PG-2069	Henkel	C_{9-11} alkylpolyglycoside
Arcosolve DPM	Arco	dipropyleneglycol monomethyl ether
Dowanol PNB	Dow	propylene glycol n-butyl ether
Dowanol TPNB	Dow	tripropylene glycol n-butyl ether
Emerest 2661	Henkel	PEG-12 laurate
Ethomeen T/25	Akzo	tallowamine 15EO
Fluorad FC-754	3M	fluorinated alkyl quaternary ammonium chloride
Fluorad FC-760	3M	fluorinated alkanol EO
Genapol UD-110	Hoechst	C_{11} oxo alcohol 11EO
MON 0818	Monsanto	tallowamine 15EO-based surfactant
Neodol 1-12	Shell	C_{11} linear alcohol 12EO
Neodol 1-9	Shell	C_{11} linear alcohol 9EO
Neodol 25-12	Shell	C_{12-15} linear alcohol 12EO
Neodol 25-20	Shell	C_{12-15} linear alcohol 20EO
Neodol 25-3	Shell	C_{12-15} linear alcohol 3EO
Neodol 45-13	Shell	C_{14-15} linear alcohol 13EO
Neodox 25-11	Shell	C_{12-15} linear alcohol ethoxycarboxylate 11EO
Orchex 796	Exxon	paraffinic oil
Pluronic F-108	BASF	128EO-54PO-128EO block copolymer
Pluronic F-127	BASF	98EO-67PO-98EO block copolymer
Pluronic F-68	BASF	75EO-30PO-75EO block copolymer
Sident 9	Degussa	abrasive silica, 50 m^2/g
Sipernat 22	Degussa	hydrophilic precipitated silica, 190 m^2/g, av. aggregate size 100 μm
Sipernat 22S	Degussa	hydrophilic precipitated silica, 190 m^2/g, av. aggregate size <10 μm
Span 60	ICI	sorbitan monostearate
Span 80	ICI	sorbitan monooleate
Stepfac 8170	Stepan	nonylphenol EO phosphate
Surfynol 104	Air Products	tetramethyldecyne diol
Tergitol 15-S-15	Union Carbide	C_{15} branched secondary alcohol 15EO
Tergitol 15-S-20	Union Carbide	C_{15} branched secondary alcohol 20EO
Tergitol 15-S-30	Union Carbide	C_{15} branched secondary alcohol 30EO
Tergitol 15-S-40	Union Carbide	C_{15} branched secondary alcohol 40EO

Trade name	Manufacturer	Chemical description
Tween 20	ICI	sorbitan monolaurate 20EO
Tween 80	ICI	sorbitan monooleate 20EO
Velvetex AB-45	Henkel	cocobetaine

Fatty alcohol ethoxylate (alkylether) surfactants are referred to in the Examples by their generic names as given in the International Cosmetic Ingredient Dictionary, 6th Edition, 1995 (Cosmetic, Toiletry and Fragrance Association, Washington, DC). They were interchangeably sourced from various manufacturers, for example:

Laureth-23: Brij 35 (ICI), Trycol 5964 (Henkel).

Ceteth-10: Brij 56 (ICI).

Ceteth-20: Brij 58 (ICI).

Steareth-10: Brij 76 (ICI).

Steareth-20: Brij 78 (ICI), Emthox 5888-A (Henkel), STA-20 (Heterene).

Steareth-30: STA-30 (Heterene).

Steareth-100: Brij 700 (ICI).

Ceteareth-15: CS-15 (Heterene).

Ceteareth-20: CS-20 (Heterene).

Ceteareth-27: Plurafac A-38 (BASF).

Ceteareth-55: Plurafac A-39 (BASF).

Oleth-2: Brij 92 (ICI).

Oleth-10: Brij 97 (ICI).

Oleth-20: Brij 98 (ICI), Trycol 5971 (Henkel).

Where a proprietary excipient is a surfactant supplied as a solution in water or other solvent, the amount to be used was calculated on a true surfactant basis, not an "as is" basis. For example, Fluorad FC-135 is supplied as 50% true surfactant, together with 33% isopropanol and 17% water; thus to provide a composition containing 0.1% w/w Fluorad FC-135 as reported herein, 0.2 g of the product as supplied was included in 100 g of the composition. The amount of lecithin, however, is always reported herein on an "as is" basis, regardless of the content of phospholipid in the lecithin sample used.

Spray compositions of the Examples contained an exogenous chemical, such as glyphosate IPA salt, in addition to the excipient ingredients listed. The amount of exogenous chemical was selected to provide the desired rate in grams per hectare (g/ha) when applied in a spray volume of 93 l/ha. Several exogenous chemical rates were applied for each composition. Thus, except where otherwise indicated, when spray compositions were tested, the concentration of exogenous chemical varied in direct proportion to exogenous chemical rate, but the concentration of excipient ingredients was held constant across different exogenous chemical rates.

Concentrate compositions were tested by dilution, dissolution or dispersion in water to form

spray compositions. In these spray compositions prepared from concentrates, the concentration of excipient ingredients varied with that of exogenous chemical.

Many of the Examples feature aqueous concentrate compositions of the invention. Except where otherwise indicated, these aqueous concentrate compositions were prepared by the following general processes (v) to (x).

(v) A weighed amount of lecithin powder of the type indicated was placed in a beaker and deionized water was added in sufficient quantity to provide, after sonication as detailed below, a lecithin stock at a convenient concentration, normally in the range from 10% to 20% w/w and typically 15% w/w. The beaker and its contents were then placed in a Fisher Sonic Dismembrator, Model 550, fitted with a 2.4 cm probe tip with the pulse period set at 15 seconds with 1 minute intervals between pulses to allow cooling. Power output was set at level 8. After a total of 3 minutes of sonication (12 pulse periods) the resulting lecithin stock was finally adjusted to the desired concentration if necessary with deionized water. To prepare an aqueous concentrate formulation, the following ingredients were mixed in the appropriate proportions with mild agitation, normally in the order given although this was sometimes varied and was found in some cases to affect the physical stability of the concentrate formulation: (a) exogenous chemical, for example glyphosate IPA salt as a 62% w/w solution at pH 4.4-4.6; (b) lecithin stock; (c) other ingredients if required; and (d) water.

(vi) Water-in-oil-in-water (W/O/W) multiple emulsions were prepared as follows. First a water-in-oil emulsion was prepared. To do this, the required amounts of the selected oil and a first emulsifier (referred to in the Examples as "emulsifier #1") were mixed thoroughly. If it was desired to prepare the formulation with glyphosate in the inner aqueous phase, a measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the mixture of oil and first emulsifier with agitation to ensure homogeneity. The amount of water required in the inner aqueous phase was then added to complete the water-in-oil emulsion, which was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a fine emulsor screen operated for 3 minutes at 10,000 rpm. The required amount of a second emulsifier (referred to in the Examples as "emulsifier #2") was next added to the water-in-oil emulsion with agitation to ensure homogeneity. If it was desired to prepare the formulation with glyphosate in the outer aqueous phase, a measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the blend of the water-in-oil emulsion and the second emulsifier with further agitation. To complete the water-in-oil-in-water multiple emulsion composition, the amount of water required in the outer aqueous phase was added. The composition was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(vii) Oil-in-water (O/W) emulsions were prepared as follows. The required amount of the selected oil and surfactant (sometimes referred to in the Examples as "emulsifier #2" as it corresponds to the second emulsifier in process (vi)) were mixed thoroughly. If the surfactant selected was not free-

flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before mixing with the oil. A measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the surfactant-oil mixture with agitation. The required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level . The composition was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(viii) Surfactant-containing aqueous solution concentrates having no oil component were prepared as follows. A concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added in the desired amount to a weighed quantity of the selected surfactant(s). If the surfactant selected is not free-flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before adding the glyphosate solution. The required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level. The composition was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(ix) For compositions containing a colloidal particulate, the required amount by weight of the selected colloidal particulate was suspended in a concentrated (62% w/w) aqueous solution of glyphosate IPA salt and agitated with cooling to ensure homogeneity. To the resulting suspension was added the required amount by weight of the selected surfactant(s). For a surfactant which is not free-flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before adding it to the suspension. In those instances where an oil, such as butyl stearate, was also to be included in the composition, the oil was first thoroughly mixed with the surfactant and the surfactant-oil mixture added to the suspension. To complete the aqueous concentrate, the required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level. The concentrate was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(x) The procedure for preparing aqueous concentrate formulations containing lecithin and butyl stearate was different from that followed for other lecithin-containing concentrates. Exogenous chemical, for example glyphosate IPA salt, was first added, with mild agitation, to deionized water in a formulation jar. The selected surfactant (other than lecithin) was then added, while continuing the agitation, to form a preliminary exogenous chemical/ surfactant mixture. Where the surfactant is not free-flowing at ambient temperature, the order of addition was not as above. Instead, the non-free-flowing surfactant was first added to water together with any other surfactant (other than lecithin) required in the composition, and was then heated to 55°C in a shaker bath for 2 hours. The resulting mixture was allowed to cool, then exogenous chemical was added with mild agitation to form the preliminary exogenous chemical/surfactant mixture. A weighed amount of the selected lecithin was added to the preliminary exogenous chemical/surfactant mixture, with stirring to break up lumps. The

mixture was left for about 1 hour to allow the lecithin to hydrate, then butyl stearate was added, with further stirring until no phase separation occurred. The mixture was then transferred to a microfluidizer (Microfluidics International Corporation, Model M-110F) and microfluidized for 3 to 5 cycles at 10,000 psi (69 MPa). In each cycle, the formulation jar was rinsed with microfluidized mixture. In the last cycle, the finished composition was collected in a clean dry beaker.

The following procedure was used for testing compositions of the Examples to determine herbicidal effectiveness, except where otherwise indicated.

Seeds of the plant species indicated were planted in 85 mm square pots in a soil mix which was previously steam sterilized and prefertilized with a 14-14-14 NPK slow release fertilizer at a rate of 3.6 kg/m^3. The pots were placed in a greenhouse with sub-irrigation. About one week after emergence, seedlings were thinned as needed, including removal of any unhealthy or abnormal plants, to create a uniform series of test pots.

The plants were maintained for the duration of the test in the greenhouse where they received a minimum of 14 hours of light per day. If natural light was insufficient to achieve the daily requirement, artificial light with an intensity of approximately 475 microeinsteins was used to make up the difference. Exposure temperatures were not precisely controlled but averaged about 27°C during the day and about 18°C during the night. Plants were sub-irrigated throughout the test to ensure adequate soil moisture levels.

Pots were assigned to different treatments in a fully randomized experimental design with 3 replications. A set of pots was left untreated as a reference against which effects of the treatments could later be evaluated.

Application of glyphosate compositions was made by spraying with a track sprayer fitted with a 9501E nozzle calibrated to deliver a spray volume of 93 liters per hectare (l/ha) at a pressure of 166 kilopascals (kPa). After treatment, pots were returned to the greenhouse until ready for evaluation.

Treatments were made using dilute aqueous compositions. These could be prepared as spray compositions directly from their ingredients, or by dilution with water of preformulated concentrate compositions.

For evaluation of herbicidal effectiveness, all plants in the test were examined by a single practiced technician, who recorded percent inhibition, a visual measurement of the effectiveness of each treatment by comparison with untreated plants. Inhibition of 0% indicates no effect, and inhibition of 100% indicates that all of the plants are completely dead. Inhibition of 85% or more is in most cases considered acceptable for normal herbicidal use; however in greenhouse tests such as those of the Examples it is normal to apply compositions at rates which give less than 85% inhibition, as this makes it easier to discriminate among compositions having different levels of effectiveness.

EXAMPLE 1

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient

ingredients as shown in Table 1a. These compositions are water-in-oil-in-water multiple emulsions and were prepared by process (vi) described above.

Table 1a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #1	Emulsifier #2
	Glyphosate a.e.	Butyl stearate	Emulsifier #1	Emulsifier #2	Water	Glyphosate		
1-01	10	18.0	3.0	5.0	9.0	20	Span 80	Tween 20
1-02	10	7.5	3.0	5.0	4.5	20	Span 80	Tween 20
1-03	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Neodol 25-12
1-04	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Neodol 25-20
1-05	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Tergitol 15-S-15
1-06	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Tergitol 15-S-20
1-07	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Tween 20
1-08	10	7.5	3.0	10.0	4.5	20	Surfynol 104	ceteareth-55
1-09	10	7.5	3.0	10.0	4.5	20	Surfynol 104	Tergitol 15-S-30
1-10	10	7.5	3.0	10.0	4.5	20	Neodol 25-3	ceteareth-55
1-11	10	7.5	3.0	10.0	4.5	20	Neodol 25-3	Tergitol 15-S-30
1-12	10	7.5	3.0	10.0	4.5	20	Span 60	ceteareth-55
1-13	10	7.5	3.0	10.0	4.5	20	Span 60	Tergitol 15-S-30
1-14	10	7.5	3.0	10.0	4.5	20	oleth-2	ceteareth-55
1-15	10	7.5	3.0	10.0	4.5	20	oleth-2	Tergitol 15-S-30
1-16	10	7.5	3.0	10.0	4.5	20	Emid 6545	ceteareth-55
1-17	10	7.5	3.0	10.0	4.5	20	Emid 6545	Tergitol 15-S-30

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 35 days after planting ABUTH and 33 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 1b.

Table 1b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	35	40
	350	50	63
	450	60	43
Formulation C	150	63	63
	250	80	96
	350	92	98
	450	98	87
Formulation J	150	43	30
	250	75	85
	350	82	98
	450	96	95

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
1-01	150	65	53
	250	85	70
	350	90	87
	450	98	73
1-02	150	63	5
	250	78	53
	350	88	80
	450	97	87
1-03	150	75	0
	250	87	22
	350	88	72
	450	97	17
1-04	150	84	0
	250	90	10
	350	95	70
	450	98	60
1-05	150	77	0
	250	83	3
	350	93	30
	450	95	10
1-06	150	72	0
	250	83	47
	350	94	60
	450	98	20
1-07	150	75	0
	250	77	40
	350	96	47
	450	96	50
1-08	150	87	40
	250	97	82
	350	99	83
	450	100	77
1-19	150	82	10
	250	82	40
	350	96	67
	450	97	67
1-10	150	82	13
	250	94	83
	350	99	85
	450	99	83
1-11	150	73	17
	250	83	60
	350	88	73
	450	96	63
1-12	150	80	20
	250	93	85
	350	96	82
	450	96	82

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
1-13	150	78	20
	250	83	50
	350	92	90
	450	92	85
1-14	150	80	30
	250	97	85
	350	99	99
	450	97	96
1-15	150	82	30
	250	87	75
	350	99	92
	450	99	93
1-16	150	82	53
	250	96	82
	350	96	97
	450	87	82
1-17	150	72	20
	250	80	63
	350	92	75
	450	95	87

Considerable variation was seen in herbicidal effectiveness of water-in-oil-in-water multiple emulsions of this Example, especially on ECHCF. Among the most efficacious were 1-08, 1-10, 1-12, 1-14 and 1-16. All of these contained a C_{16-18} alkylether surfactant, ceteareth-55. When Tergitol 15-S-30, a C_{12-15} secondary alkylether surfactant, replaced ceteareth-55, as in 1-09, 1-11, 1-13, 1-15 and 1-17, herbicidal effectiveness, at least on ECHCF, was in most cases markedly reduced.

EXAMPLE 2

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 2a. Concentrate compositions 2-01 and 2-02 are water-in-oil-in-water multiple emulsions and were prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 2-03 to 2-12 and 2-14 to 2-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 2-13 is an aqueous solution concentrate and was prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 2a

Conc. comp.	% w/w				% in inner aq. Phase		Emulsifier #2
	Glyphosate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
2-01	10	18.0	3.0	5.0	12.2	20	Tween 20
2-02	10	7.5	3.0	5.0	5.3	20	Tween 20
2-03	10	1.0		10.0			Neodol 25-20
2-04	10	3.0		10.0			Neodol 25-20
2-05	10	1.0		5.0			Neodol 25-20

Conc. comp.	% w/w				% in inner aq. Phase		Emulsifier #2
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
2-06	10	3.0		5.0			Neodol 25-20
2-07	15	1.0		10.0			Neodol 25-20
2-08	15	3.0		10.0			Neodol 25-20
2-09	15	1.0		5.0			Neodol 25-20
2-10	15	3.0		5.0			Neodol 25-20
2-11	20	1.0		5.0			Neodol 25-20
2-12	20	1.0		10.0			Neodol 25-20
2-13	10			10.0			Neodol 25-20
2-14	10	7.5		10.0			Neodol 25-20
2-15	10	7.5		10.0			Neodol 25-12
2-16	10	7.5		10.0			steareth-20
2-17	10	7.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 2b.

Table 2b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	30
	250	10	40
	350	37	73
	450	58	68
Formulation C	150	42	79
	250	77	98
	350	99	97
	450	97	93
Formulation J	150	43	67
	250	73	90
	350	94	98
	450	77	78
2-01	150	58	76
	250	75	77
	350	88	93
	450	95	83
2-02	150	27	63
	250	60	87
	350	82	98
	450	77	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
2-03	150	47	76
	250	65	92
	350	94	99
	450	95	91
2-04	150	70	86
	250	86	95
	350	97	98
	450	99	90
2-05	150	42	80
	250	72	90
	350	90	93
	450	99	96
2-06	150	48	57
	250	78	92
	350	94	99
	450	96	92
2-07	150	78	95
	250	96	96
	350	98	98
	450	100	97
2-08	150	88	96
	250	98	98
	350	100	99
	450	100	99
2-09	150	82	93
	250	94	96
	350	99	97
	450	99	93
2-10	150	72	83
	250	97	93
	350	99	100
	450	100	98
2-11	150	87	83
	250	98	97
	350	100	99
	450	100	99
2-12	150	93	99
	250	99	99
	350	99	97
	450	100	99
2-13	150	70	90
	250	91	88
	350	97	94
	450	99	86
2-14	150	67	76
	250	93	80
	350	98	95
	450	95	78

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
2-15	150	68	65
	250	90	87
	350	97	80
	450	98	93
2-16	150	83	73
	250	90	93
	350	99	100
	450	100	100
2-17	150	80	66
	250	98	77
	350	99	83
	450	100	85

Very high herbicidal activity was evident in compositions 2-13 to 2-17, which have a very high ratio of surfactant to glyphosate a.e. of 1:1. Activity was too high to clearly distinguish among these compositions, but 2-16 and 2-17, containing steareth-20 and oleth-20 respectively, exbited greater effectiveness on ABUTH at the lowest glyphosate rate than 2-14 and 2-15, containing Neodol 25-20 and Neodol 25-12 respectively.

EXAMPLE 3

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 3a. Concentrate compositions 3-01 and 3-02 are water-in-oil-in-water multiple emulsions and were prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 3-03 to 3-12 and 3-14 to 3-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 3-13 is an aqueous solution concentrate and was prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 3a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	#2
3-01	10	18.0	3.0	5.0	12.2	20	Tween 20
3-02	10	7.5	3.0	5.0	5.3	20	Tween 20
3-03	10	1.0		10.0			Tween 80
3-04	10	3.0		10.0			Tween 80
3-05	10	1.0		5.0			Tween 80
3-06	10	3.0		5.0			Tween 80
3-07	15	1.0		10.0			Tween 80
3-08	15	3.0		10.0			Tween 80
3-09	15	1.0		5.0			Tween 80
3-10	15	3.0		5.0			Tween 80
3-11	20	1.0		5.0			Tween 80
3-12	20	1.0		10.0			Tween 80
3-13	10			10.0			Tween 80
3-14	10	7.5		10.0			Tween 80

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
3-15	10	7.5		10.0			Neodol 25-20
3-16	10	7.5		10.0			steareth-20
3-17	10	7.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 3b.

Table 3b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	3	10
	350	17	20
	450	20	30
Formulation C	150	70	33
	250	80	70
	350	85	80
	450	97	77
Formulation J	150	7	20
	250	70	80
	350	78	80
	450	83	80
3-01	150	40	7
	250	48	20
	350	73	23
	450	75	30
3-02	150	3	0
	250	10	17
	350	47	23
	450	50	30
3-03	150	0	2
	250	33	13
	350	63	40
	450	68	43
3-04	150	17	7
	250	43	20
	350	78	63
	450	78	63

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
3-05	150	10	3
	250	20	13
	350	58	40
	450	75	40
3-06	150	3	0
	250	27	20
	350	60	23
	450	72	23
3-07	150	32	10
	250	68	20
	350	75	50
	450	86	60
3-08	150	27	20
	250	68	30
	350	82	40
	450	90	73
3-09	150	43	10
	250	60	33
	350	72	63
	450	75	73
3-10	150	33	10
	250	62	30
	350	77	60
	450	83	70
3-11	150	48	13
	250	72	63
	350	83	80
	450	87	80
3-12	150	23	13
	250	60	50
	350	75	80
	450	86	78
3-13	150	32	13
	250	47	40
	350	75	50
	450	78	70
3-14	150	27	20
	250	75	53
	350	82	70
	450	92	67
3-15	150	70	20
	250	78	30
	350	92	80
	450	93	80
3-16	150	68	40
	250	73	30
	350	93	80
	450	93	77

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
3-17	150	73	20
	250	85	30
	350	93	60
	450	95	63

Compositions 3-16 and 3-17, containing steareth-20 and oleth-20 respectively, exhibited very high herbicidal activity on ABUTH. At the very high surfactant to glyphosate a.e. ratio (1:1) of these compositions, no difference was evident between these compositions and an otherwise similar composition (3-15) containing Neodol 25-20 in place of steareth-20 or oleth-20.

EXAMPLE 4

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 4a. All are oil-in-water emulsions and were prepared by process (vii).

Table 4a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
4-01	163	1.00	10.0	Tween 80
4-02	163	1.00	10.0	Neodol 25-12
4-03	163	1.00	10.0	Neodol 25-20
4-04	163	1.00	10.0	steareth-20
4-05	163	1.00	10.0	oleth-20
4-06	163	1.00	10.0	Tergitol 15-S-40
4-07	163	1.00	10.0	Tergitol 15-S-15
4-08	163	1.00	10.0	Tergitol 15-S-20
4-09	163	0.50	10.0	Tergitol 15-S-40
4-10	163	0.50	10.0	Tergitol 15-S-15
4-11	163	0.50	10.0	Tergitol 15-S-20
4-12	163	0.50	5.0	Tergitol 15-S-40
4-13	163	0.50	5.0	Tergitol 15-S-15
4-14	163	0.50	5.0	Tergitol 15-S-20
4-15	163	0.25	10.0	Tergitol 15-S-40

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 4b.

Table 4b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	20
	250	2	30
	350	5	53
	450	45	75
Formulation C	150	45	63
	250	77	93
	350	83	99
	450	93	100
Formulation J	150	15	40
	250	70	73
	350	78	98
	450	92	99
4-01	150	42	50
	250	72	89
	350	80	96
	450	93	98
4-02	150	45	80
	250	72	83
	350	85	91
	450	97	98
4-03	150	60	80
	250	75	87
	350	82	96
	450	86	99
4-04	150	65	60
	250	82	70
	350	93	80
	450	98	87
4-05	150	72	60
	250	83	87
	350	95	93
	450	98	97
4-06	150	50	45
	250	68	70
	350	77	85
	450	83	90
4-07	150	25	40
	250	65	50
	350	80	77
	450	83	80
4-08	150	37	33
	250	72	80
	350	77	87
	450	80	90

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
4-09	150	32	47
	250	65	73
	350	77	75
	450	80	94
4-10	150	17	30
	250	65	70
	350	75	70
	450	78	89
4-11	150	35	33
	250	68	68
	350	77	77
	450	92	75
4-12	150	13	35
	250	57	40
	350	75	57
	450	77	83
4-13	150	35	40
	250	63	43
	350	77	77
	450	83	75
4-14	150	30	25
	250	67	53
	350	78	85
	450	83	77
4-15	150	13	37
	250	65	50
	350	77	57
	450	87	82

At a surfactant to glyphosate a.e. weight/weight ratio of about 1:1.5, compositions containing steareth-20 or oleth-20 (4-04 and 4-05 respectively) exhibited herbicidal effectiveness on ABUTH similar to one containing Neodol 25-20 (4-03).

EXAMPLE 5

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 5a. All are oil-in-water emulsions and were prepared by process (vii).

Table 5a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
5-01	163	1.0	10.0	Tween 80
5-02	163	1.0	10.0	Neodol 25-12
5-03	163	1.0	10.0	Neodol 25-20
5-04	163	1.0	10.0	steareth-20
5-05	163	1.0	10.0	oleth-20
5-06	163	1.0	10.0	Tergitol 15-S-40

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
5-07	163	1.0	10.0	Tergitol 15-S-15
5-08	163	1.0	10.0	Tergitol 15-S-20
5-09	163	0.5	10.0	Tergitol 15-S-40
5-10	163	0.3	10.0	Tergitol 15-S-15
5-11	163	0.3	10.0	Tergitol 15-S-20
5-12	163	0.3	10.0	Tergitol 15-S-40
5-13	163	0.3	5.0	Tergitol 15-S-15
5-14	163	0.3	5.0	Tergitol 15-S-20
5-15	163	0.3	5.0	Tergitol 15-S-40

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 5b.

Table 5b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	23
	250	0	40
	350	5	53
	450	13	57
Formulation C	150	0	47
	250	28	87
	350	72	98
	450	97	97
Formulation J	150	5	40
	250	20	63
	350	67	93
	450	82	92
5-01	150	2	40
	250	30	50
	350	50	70
	450	57	85
5-02	150	10	50
	250	33	50
	350	75	72
	450	75	88
5-03	150	17	53
	250	60	60
	350	70	92
	450	78	94

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
5-04	150	57	45
	250	70	70
	350	82	93
	450	83	95
5-05	150	47	45
	250	70	80
	350	80	88
	450	88	92
5-06	150	2	42
	250	20	60
	350	35	75
	450	58	89
5-07	150	0	42
	250	30	68
	350	40	75
	450	77	82
5-08	150	2	40
	250	25	60
	350	50	83
	450	75	86
5-09	150	2	43
	250	27	83
	350	40	73
	450	70	78
5-10	150	2	42
	250	32	47
	350	43	63
	450	70	82
5-11	150	0	30
	250	25	53
	350	35	75
	450	70	75
5-12	150	2	40
	250	13	57
	350	25	75
	450	40	83
5-13	150	5	42
	250	23	62
	350	38	63
	450	67	60
5-14	150	2	33
	250	13	48
	350	30	53
	450	70	88
5-15	150	2	33
	250	18	48
	350	30	75
	450	43	65

In this test, herbicidal effectiveness overall was lower than in the previous Example, particularly on ABUTH. In these circumstances, at a surfactant to glyphosate a.e. weight/weight ratio of about 1:1.5, compositions containing steareth-20 or oleth-20 (5-04 and 5-05 respectively) exhibited greater herbicidal effectiveness on both ABUTH and ECHCF than one containing Neodol 25-20 (5-03).

EXAMPLE 6

Aqueous concentrate compositions were prepared containing glyphosate ammonium or IPA salt and excipient ingredients as shown in Table 6a. Concentrate composition 6-01 is a water-in-oil-in-water multiple emulsion and was prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 6-02 to 6-11 and 6-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 6-12 to 6-16 are aqueous solution concentrates and were prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 6a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2	Glyphosate salt
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate		
6-01	10	18.0	3.0	5.0	9.0	20	Tween 20	IPA
6-02	15	1.0		10.0			Tween 80	IPA
6-03	15	1.0		10.0			Neodol 25-12	IPA
6-04	15	1.0		10.0			Neodol 25-20	IPA
6-05	15	1.0		10.0			steareth-20	IPA
6-06	15	1.0		10.0			oleth-20	IPA
6-07	15	1.0		10.0			Tween 80	ammonium
6-08	15	1.0		10.0			Neodol 25-12	ammonium
6-09	15	1.0		10.0			Neodol 25-20	ammonium
6-10	15	1.0		10.0			steareth-20	ammonium
6-11	15	1.0		10.0			oleth-20	ammonium
6-12	15			10.0			Tween 80	IPA
6-13	15			10.0			Neodol 25-12	IPA
6-14	15			10.0			Neodol 25-20	IPA
6-15	15			10.0			steareth-20	IPA
6-16	15			10.0			oleth-20	IPA
6-17	15	1.0		10.0			Emerest 2661	IPA

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 6b.

Table 6b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	5
	250	3	25
	350	28	30
	450	53	50
Formulation C	150	5	25
	250	60	50
	350	85	83
	450	88	88
Formulation J	150	2	10
	250	70	40
	350	82	53
	450	87	83
6-01	150	23	20
	250	72	30
	350	80	80
	450	85	69
6-02	150	5	18
	250	72	38
	350	82	63
	450	85	83
6-03	150	25	20
	250	70	57
	350	85	68
	450	90	83
6-04	150	25	27
	250	77	67
	350	85	62
	450	88	70
6-05	150	60	25
	250	82	62
	350	87	73
	450	85	80
6-06	150	50	32
	250	78	78
	350	91	91
	450	98	98
6-07	150	5	25
	250	55	77
	350	77	86
	450	83	99
6-08	150	0	13
	250	58	78
	350	80	85
	450	85	87

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
6-09	150	7	25
	250	57	72
	350	77	83
	450	91	92
6-10	150	50	25
	250	80	55
	350	86	87
	450	92	82
6-11	150	53	30
	250	78	80
	350	87	89
	450	95	98
6-12	150	0	25
	250	50	77
	350	77	90
	450	83	94
6-13	150	2	30
	250	55	75
	350	72	92
	450	85	80
6-14	150	12	30
	250	75	78
	350	84	90
	450	96	94
6-15	150	55	35
	250	78	80
	350	80	94
	450	86	98
6-16	150	50	35
	250	73	63
	350	84	83
	450	89	95
6-17	150	0	10
	250	10	53
	350	53	83
	450	62	87

Compositions containing steareth-20 or oleth-20 (6-05, 6-06, 6-10, 6-11, 6-15, 6-16) generally exhibited superior herbicidal effectiveness to counterparts containing Neodol 25-20 (6-04, 6-09, 6-14), at least on ABUTH. The presence of a small amount of butyl stearate tended to enhance effectiveness on ABUTH (compare 6-05 and 6-06 with 6-15 and 6-16).

EXAMPLE 7

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 7a. Concentrate composition 7-01 is a water-in-oil-in-water multiple

emulsion and was prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 7-02 to 7-08, 7-14, 7-16 and 7-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 7-09 to 7-13 and 7-15 are aqueous solution concentrates and were prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 7a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2
	Glyphosate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
7-01	10	18.0	3.0	2.5	9.0	20	Tween 20
7-02	15	1.0		10.0			Emerest 2661
7-03	15	1.0		10.0			Tween 80
7-04	15	1.0		10.0			oleth-20
7-05	15	1.0		10.0			Neodol 25-20
7-06	15	1.0		10.0			ceteareth-27
7-07	15	1.0		10.0			ceteareth-55
7-08	15	1.0		10.0			Genapol UD-110
7-09	15			10.0			ceteareth-27
7-10	15			10.0			ceteareth-55
7-11	15			10.0			Genapol UD-110
7-12	15			10.0			oleth-20
7-13	10			10.0			oleth-20
7-14	10	1.0		10.0			oleth-20
7-15	20			10.0			oleth-20
7-16	15	0.5		5.0			oleth-20
7-17	15	0.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 7b.

Table 7b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	8	20
	350	27	40
	450	62	50
Formulation C	150	27	50
	250	75	70
	350	92	80
	450	97	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	23	30
	250	72	50
	350	94	63
	450	95	80
7-01	150	22	30
	250	60	40
	350	83	57
	450	90	67
7-02	150	12	33
	250	45	50
	350	73	63
	450	83	83
7-03	150	27	43
	250	68	50
	350	80	63
	450	87	87
7-04	150	68	47
	250	95	73
	350	99	78
	450	95	90
7-05	150	50	50
	250	77	77
	350	90	83
	450	98	83
7-06	150	78	67
	250	93	82
	350	97	87
	450	99	97
7-07	150	87	57
	250	96	73
	350	99	85
	450	99	97
7-08	150	42	30
	250	73	53
	350	82	85
	450	95	89
7-09	150	67	40
	250	95	73
	350	99	95
	450	99	98
7-10	150	85	60
	250	96	68
	350	96	91
	450	100	88
7-11	150	13	10
	250	67	50
	350	78	60
	450	88	73

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
7-12	150	72	43
	250	97	68
	350	98	83
	450	99	93
7-13	150	73	57
	250	88	70
	350	98	87
	450	99	96
7-14	150	80	50
	250	96	70
	350	99	85
	450	98	88
7-15	150	70	43
	250	96	53
	350	97	82
	450	99	89
7-16	150	62	53
	250	88	72
	350	99	81
	450	99	91
7-17	150	72	58
	250	95	68
	350	100	89
	450	100	93

The greatest herbicidal effectiveness in this test was exhibited by compositions containing a C_{16-18} alkylether surfactant (oleth-20, ceteareth-27 or ceteareth-55).

EXAMPLE 8

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 8a. All are oil-in-water emulsions and were prepared by process (vii).

Table 8a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
8-01	163	1.00	10.0	Tween 80
8-02	163	1.00	10.0	Emerest 2661
8-03	326	1.00	10.0	Genapol UD-110
8-04	326	0.50	10.0	Genapol UD-110
8-05	326	0.25	10.0	Genapol UD-110
8-06	163	0.25	10.0	Genapol UD-110
8-07	163	1.00	10.0	Genapol UD-110
8-08	163	1.00	10.0	Neodol 1-9
8-09	163	1.00	10.0	Neodol 1-12
8-10	163	1.00	10.0	Neodol 25-20
8-11	163	1.00	10.0	Neodol 25-12

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
8-12	163	1.00	10.0	Neodox 25-11
8-13	163	1.00	10.0	laureth-23
8-14	163	1.00	10.0	ceteth-20
8-15	163	1.00	10.0	steareth-20
8-16	163	1.00	10.0	oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 23 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 8b.

Table 8b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	25	22
	350	60	40
	450	65	52
Formulation C	150	43	52
	250	72	83
	350	87	98
	450	97	95
Formulation J	150	50	43
	250	75	91
	350	86	96
	450	95	97
8-01	150	50	30
	250	75	75
	350	85	87
	450	90	92
8-02	150	35	47
	250	58	77
	350	75	85
	450	80	96
8-03	150	33	32
	250	57	53
	350	75	78
	450	84	94
8-04	150	20	25
	250	55	68
	350	78	91
	450	82	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
8-05	150	37	12
	250	58	42
	350	81	70
	450	86	73
8-06	150	50	8
	250	65	40
	350	81	65
	450	92	85
8-07	150	50	30
	250	63	48
	350	84	68
	450	98	84
8-08	150	43	35
	250	52	65
	350	73	85
	450	84	85
8-09	150	55	40
	250	68	58
	350	79	65
	450	97	73
8-10	150	69	40
	250	81	68
	350	94	92
	450	99	96
8-11	150	58	50
	250	84	60
	350	90	83
	450	94	93
8-12	150	50	40
	250	57	67
	350	65	84
	450	75	98
8-13	150	57	53
	250	78	73
	350	89	97
	450	98	97
8-14	150	68	67
	250	85	73
	350	97	98
	450	100	97
8-15	150	72	50
	250	88	89
	350	89	98
	450	99	97
8-16	150	65	53
	250	87	72
	350	97	85
	450	100	95

Activity overall in this test was very high, and differences among compositions in herbicidal effectivess are difficult to discern clearly.

EXAMPLE 9

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 9a. All are oil-in-water emulsions and were prepared by process (vii).

Table 9a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
9-01	163	1.00	10.0	Tween 80
9-02	163	1.00	10.0	Emerest 2661
9-03	163	1.00	10.0	Neodol 25-20
9-04	163	1.00	10.0	oleth-20
9-05	163	0.50	5.0	oleth-20
9-06	163	0.25	2.5	oleth-20
9-07	163	0.50	2.5	oleth-20
9-08	163	0.50	1.0	oleth-20
9-09	163	0.25	5.0	oleth-20
9-10	326	1.00	10.0	Neodol 1-12
9-11	326	0.50	10.0	Neodol 1-12
9-12	326	0.25	10.0	Neodol 1-12
9-13	326	1.00	5.0	Neodol 1-12
9-14	326	0.50	5.0	Neodol 1-12
9-15	326	0.25	5.0	Neodol 1-12
9-16	326	0.10	5.0	Neodol 1-12

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 9b.

Table 9b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	7	50
	250	45	60
	350	73	73
	450	80	78
Formulation C	150	75	77
	250	87	100
	350	96	99
	450	99	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	72	77
	250	83	89
	350	97	99
	450	97	98
9-01	150	60	75
	250	80	85
	350	93	97
	450	98	98
9-02	150	57	75
	250	70	83
	350	87	83
	450	90	94
9-03	150	77	80
	250	87	92
	350	97	87
	450	99	98
9-04	150	80	89
	250	93	92
	350	99	99
	450	100	99
9-05	150	83	83
	250	92	93
	350	97	90
	450	100	93
9-06	150	77	77
	250	80	91
	350	90	99
	450	98	99
9-07	150	77	83
	250	82	89
	350	90	91
	450	97	98
9-08	150	47	82
	250	73	82
	350	80	97
	450	92	91
9-09	150	73	78
	250	87	88
	350	97	94
	450	99	99
9-10	150	52	67
	250	70	80
	350	93	88
	450	93	94
9-11	150	40	68
	250	72	85
	350	87	96
	450	93	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
9-12	150	37	60
	250	68	83
	350	85	85
	450	93	75
9-13	150	28	63
	250	53	80
	350	85	97
	450	88	97
9-14	150	37	63
	250	58	73
	350	83	96
	450	90	91
9-15	150	30	70
	250	47	83
	350	82	89
	450	87	89
9-16	150	40	53
	250	53	82
	350	80	80
	450	88	77

Composition 9-04, containing 1% butyl stearate and 10% oleth-20 (surfactant to glyphosate a.e. weight/weight ratio about 1:1.5), exhibited marginally greater herbicidal effectiveness than composition 9-03, containing 1% butyl stearate and 10% oleth-20. At this very high surfactant to glyphosate ratio, however, both performed extremely well. Surprisingly, when the butyl stearate and oleth-20 concentrations were significantly lowered, this high level of performance was maintained to a remarkable degree. Even when butyl stearate was reduced to 0.25% and oleth-20 to 2.5% (surfactant to glyphosate a.e. ratio about 1:6), as in composition 9-06, herbicidal effectiveness was still similar to that obtained with commercial standard Formulations C and J.

EXAMPLE 10

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 10a. Concentrate compositions 10-01 to 10-08 and 10-11 to 10-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 10-09 and 10-10 are aqueous solution concentrates and were prepared by process (viii).

Table 10a

Concentrate composition	% w/w			Type of surfactant
	Glyphosate a.e.	Butyl stearate	Surfactant	
10-01	15.0	0.25	5.0	Emerest 2661
10-02	15.0	0.25	5.0	Tween 80
10-03	15.0	0.25	5.0	Neodol 25-20
10-04	15.0	0.25	5.0	laureth-23

Concentrate composition	% w/w			Type of surfactant
	Glyphosate a.e.	Butyl stearate	Surfactant	
10-05	15.0	0.25	5.0	ceteth-20
10-06	15.0	0.25	2.5	Tween 80
10-07	15.0	0.10	1.0	Tween 80
10-08	15.0	1.00	10.0	Tween 80
10-09	15.0		5.0	laureth-23
10-10	15.0		5.0	ceteth-20
10-11	15.0	1.00	10.0	Neodol 25-20
10-12	15.0	1.00	10.0	oleth-20
10-13	15.0	0.50	5.0	oleth-20
10-14	15.0	0.25	5.0	oleth-20
10-15	15.0	0.25	2.5	oleth-20
10-16	15.0	0.25	5.0	Genapol UD-110

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 12 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 10b.

Table 10b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	10
	250	5	20
	350	43	30
	450	58	43
Formulation C	150	68	50
	250	92	79
	350	96	90
	450	98	85
Formulation J	150	57	43
	250	90	63
	350	95	80
	450	95	95
10-01	150	7	33
	250	50	43
	350	77	53
	450	80	93
10-02	150	17	50
	250	72	70
	350	80	80
	450	80	93

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
10-03	150	43	40
	250	75	68
	350	87	75
	450	96	95
10-04	150	33	47
	250	73	63
	350	80	77
	450	90	93
10-05	150	73	37
	250	92	57
	350	95	88
	450	95	73
10-06	150	25	35
	250	68	47
	350	80	92
	450	88	85
10-07	150	3	30
	250	57	40
	350	77	53
	450	80	67
10-08	150	53	43
	250	77	62
	350	80	88
	450	93	80
10-09	150	32	60
	250	77	53
	350	93	73
	450	97	93
10-10	150	75	35
	250	92	77
	350	96	77
	450	97	93
10-11	150	75	53
	250	90	78
	350	95	89
	450	98	97
10-12	150	80	43
	250	95	73
	350	96	92
	450	98	89
10-13	150	75	53
	250	92	97
	350	97	99
	450	96	93
10-14	150	78	70
	250	90	92
	350	93	97
	450	95	93

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
10-15	150	70	60
	250	83	98
	350	95	99
	450	97	99
10-16	150	27	52
	250	75	73
	350	80	98
	450	83	99

Extremely high herbicidal effectiveness was again observed with a composition (10-15) containing 15% glyphosate a.e. and just 2.5% oleth-20 together with 0.25% butyl stearate. A comparison of 15% glyphosate a.e. compositions containing 5% alkylether surfactant and 0.25% butyl stearate provided the following ranking of alkylethers in descending order of effectiveness: oleth-20 (10-14) > ceteth-20 (10-05) > Neodol 25-20 (10-03) = laureth-23 (10-04).

EXAMPLE 11

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 11a. All are oil-in-water emulsions and were prepared by process (vii).

Table 11a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
11-01	163	0.50	5.0	oleth-20
11-02	163	0.25	5.0	oleth-20
11-03	163	0.25	2.5	oleth-20
11-04	163	1.00	10.0	oleth-20
11-05	163	0.50	5.0	steareth-20
11-06	163	0.25	5.0	steareth-20
11-07	163	0.25	2.5	steareth-20
11-08	163	1.00	10.0	steareth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 11b.

Table 11b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	30
	250	20	43
	350	43	53
	450	68	57
Formulation C	150	60	47
	250	75	53
	350	87	80
	450	87	78
Formulation J	150	42	43
	250	83	60
	350	87	73
	450	93	87
11-01	150	60	60
	250	78	63
	350	87	89
	450	92	78
11-02	150	70	43
	250	80	91
	350	87	86
	450	96	87
11-03	150	52	43
	250	75	72
	350	83	93
	450	87	94
11-04	150	72	50
	250	93	73
	350	97	95
	450	97	91
11-05	150	72	43
	250	80	78
	350	87	91
	450	93	85
11-06	150	68	40
	250	80	50
	350	93	75
	450	95	85
11-07	150	63	37
	250	78	55
	350	87	84
	450	83	82
11-08	150	70	50
	250	80	70
	350	92	84
	450	94	98

All compositions containing butyl stearate and either oleth-20 or steareth-20 showed a very high level of performance by comparison with commercial standard Formulations C and J.

EXAMPLE 12

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 12a. All are oil-in-water emulsions and were prepared by process (vii).

Table 12a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
12-01	163	0.50	5.0	oleth-20
12-02	163	0.25	5.0	oleth-20
12-03	163	0.25	2.5	oleth-20
12-04	163	1.00	10.0	oleth-20
12-05	163	0.50	5.0	steareth-20
12-06	163	0.25	5.0	steareth-20
12-07	163	0.25	2.5	steareth-20
12-08	163	1.00	10.0	steareth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 12b.

Table 12b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	3	10
	250	28	23
	350	72	37
	450	73	50
Formulation C	150	57	43
	250	87	62
	350	93	83
	450	99	95
Formulation J	150	27	47
	250	70	53
	350	92	75
	450	94	92
12-01	150	68	50
	250	85	47
	350	97	70
	450	99	83

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
12-02	150	67	40
	250	78	50
	350	96	63
	450	99	68
12-03	150	52	40
	250	72	50
	350	95	63
	450	97	85
12-04	150	72	40
	250	97	53
	350	97	77
	450	99	90
12-05	150	75	40
	250	0	53
	350	88	53
	450	96	78
12-06	150	98	40
	250	93	50
	350	97	68
	450	97	82
12-07	150	73	40
	250	92	50
	350	98	63
	450	98	80
12-08	150	77	43
	250	93	57
	350	97	77
	450	98	88

All compositions containing butyl stearate and either oleth-20 or steareth-20 showed a very high level of performance by comparison with commercial standard Formulations C and J.

EXAMPLE 13

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 13a. All contain colloidal particulates and were prepared by process (ix).

All compositions of this example showed acceptable storage stability. The compositions containing oleth-20 were not acceptably storage-stable in the absence of the colloidal particulate.

Table 13a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Butyl stearate	Oleth-20	Aerosil	
13-01	488		3.0	0.4	OX-50
13-02	488		3.0	0.8	OX-50
13-03	488		3.0	1.5	OX-50
13-04	488			0.4	OX-50

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Butyl stearate	Oleth-20	Aerosil	
13-05	488			0.8	OX-50
13-06	488			1.5	OX-50
13-07	488		3.0	0.4	MOX-80
13-08	488		3.0	0.8	MOX-80
13-09	488		3.0	1.5	MOX-80
13-10	488			0.4	MOX-80
13-11	488			0.8	MOX-80
13-12	488			1.5	MOX-80
13-13	488		3.0	0.4	MOX-170
13-14	488		3.0	0.8	MOX-170
13-15	488		3.0	1.5	MOX-170
13-16	488			0.4	MOX-170
13-17	488			0.8	MOX-170
13-18	488			1.5	MOX-170
13-19	488	3.0	3.0	1.5	MOX-80

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 13b.

Table 13b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	27
	250	17	37
	350	47	57
	450	60	60
Formulation J	150	57	50
	250	82	87
	350	95	99
	450	98	99
13-01	150	37	60
	250	73	70
	350	96	97
	450	96	99
13-02	150	43	50
	250	73	63
	350	93	96
	450	98	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
13-03	150	53	60
	250	83	87
	350	87	97
	450	98	98
13-04	150	45	40
	250	57	60
	350	78	95
	450	94	100
13-05	150	47	50
	250	60	82
	350	92	96
	450	95	99
13-06	150	38	53
	250	68	96
	350	82	99
	450	83	95
13-07	150	50	57
	250	87	88
	350	91	99
	450	98	98
13-08	150	53	50
	250	88	85
	350	96	97
	450	97	100
13-09	150	40	30
	250	37	47
	350	57	80
	450	77	94
13-10	150	47	50
	250	70	95
	350	75	99
	450	77	98
13-11	150	27	60
	250	72	85
	350	82	98
	450	75	99
13-12	150	37	57
	250	73	86
	350	80	99
	450	85	100
13-13	150	45	53
	250	85	94
	350	95	100
	450	98	99
13-14	150	50	50
	250	78	83
	350	94	98
	450	98	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
13-15	150	53	67
	250	75	88
	350	93	97
	450	96	99
13-16	150	42	50
	250	47	96
	350	70	98
	450	90	99
13-17	150	27	83
	250	57	98
	350	87	99
	450	87	100
13-18	150	33	60
	250	47	94
	350	83	99
	450	93	99
13-19	150	45	47
	250	80	73
	350	96	94
	450	99	98

Remarkably high levels of herbicidal effectiveness were obtained in this test with compositions containing oleth-20 at a weight/weight ratio to glyphosate a.e. of about 1:14, and stabilized with colloidal particulates. In some cases the colloidal particulate alone contributed a major part of the efficacy enhancement. Results with composition 13-09 are out of line with other data and an application problem is suspected.

EXAMPLE 14

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 14a. Concentrate compositions 14-01 to 14-04, 14-06, 14-08, 14-09, 14-11, 14-12, 14-14 and 14-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 14-05, 14-07, 14-10, 14-13, 14-15 and 14-17 are aqueous solution concentrates and were prepared by process (viii).

Table 14a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
14-01	163	0.25	2.5	Neodol 1-12
14-02	163	0.25	2.5	laureth-23
14-03	163	0.25	2.5	steareth-10
14-04	163	0.25	2.5	steareth-20
14-05	163		2.5	steareth-20
14-06	163	0.25	2.5	steareth-100
14-07	163		2.5	steareth-100

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
14-08	163	0.25	2.5	oleth-10
14-09	163	0.25	2.5	oleth-20
14-10	163		2.5	oleth-20
14-11	163	0.25	2.5	ceteth-10
14-12	163	0.25	2.5	ceteth-20
14-13	163		2.5	ceteth-20
14-14	326	0.50	5.0	ceteareth-27
14-15	326		5.0	ceteareth-27
14-16	163	0.25	2.5	ceteareth-55
14-17	163		2.5	ceteareth-55

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 14b.

Table 14b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	33
	250	20	43
	350	63	63
	450	75	70
Formulation C	150	53	55
	250	80	87
	350	94	97
	450	98	99
Formulation J	150	40	57
	250	80	90
	350	96	99
	450	98	99
14-01	150	52	40
	250	65	73
	350	77	70
	450	77	70
14-02	150	37	70
	250	75	80
	350	83	97
	450	95	99
14-03	150	47	53
	250	77	86
	350	83	97
	450	93	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
14-04	150	80	60
	250	93	83
	350	96	85
	450	99	99
14-05	150	80	43
	250	93	79
	350	96	94
	450	98	96
14-06	150	77	53
	250	85	83
	350	94	99
	450	97	99
14-07	150	63	50
	250	80	88
	350	85	96
	450	96	99
14-08	150	27	45
	250	75	83
	350	77	99
	450	96	98
14-09	150	75	57
	250	80	82
	350	97	95
	450	99	98
14-10	150	70	40
	250	85	83
	350	97	98
	450	99	99
14-11	150	53	37
	250	75	63
	350	88	93
	450	92	98
14-12	150	70	40
	250	78	75
	350	90	91
	450	98	98
14-13	150	72	40
	250	92	80
	350	97	90
	450	99	97
14-14	150	78	53
	250	89	88
	350	97	95
	450	99	100
14-15	150	80	60
	250	95	97
	350	98	100
	450	99	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
14-16	150	60	63
	250	87	78
	350	96	94
	450	98	99
14-17	150	73	60
	250	85	57
	350	93	80
	450	99	85

In combination with butyl stearate, steareth-20 (composition 14-04) gave greater herbicidal effectiveness than steareth-10 (14-03) on ABUTH. Similarly, oleth-20 (14-09) was more efficacious than oleth-10 (14-08) and ceteth-20 (14-12) than ceteth-10 (14-11). In the absence of butyl stearate, ceteareth-55 (14-17) was noticeably weaker on ECHCF than ceteareth-27 (14-15) but inclusion of butyl stearate (14-16) tended to correct this weakness. Note that while compositions 14-14 and 14-15 contained twice as high a concentration of excipients as the other compositions of the test, the concentration of glyphosate was also twice as high, thus the concentrations as sprayed were the same.

EXAMPLE 15

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 15a. Concentrate compositions 15-01 to 15-05, 15-07, 15-08, 15-10 and 15-12 to 15-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 15-06, 15-09 and 15-11 are aqueous solution concentrates and were prepared by process (viii).

Table 15a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
15-01	163	0.25	2.5	Neodol 1-12
15-02	163	0.25	2.5	laureth-23
15-03	163	0.25	2.5	steareth-10
15-04	163	0.25	2.5	steareth-20
15-05	163	0.25	2.5	Pluronic F-68
15-06	163		2.5	Pluronic F-68
15-07	326	1.00	5.0	Pluronic F-108
15-08	326	0.50	5.0	Pluronic F-108
15-09	326		5.0	Pluronic F-108
15-10	163	0.25	2.5	Pluronic F-127
15-11	163		2.5	Pluronic F-127
15-12	326	0.50	5.0	ceteareth-27
15-13	163	0.25	2.5	ceteareth-55
15-14	163	0.25	2.5	oleth-20
15-15	163	0.25	2.5	ceteth-20
15-16	163	0.25	2.5	steareth-100

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 15b.

Table 15b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	5	0
	250	47	5
	350	70	23
	450	75	43
Formulation C	150	73	47
	250	99	50
	350	98	67
	450	99	75
Formulation J	150	73	43
	250	89	50
	350	97	83
	450	98	77
15-01	150	37	30
	250	70	33
	350	77	40
	450	90	47
15-02	150	52	37
	250	77	67
	350	90	77
	450	92	75
15-03	150	40	30
	250	77	70
	350	80	82
	450	90	83
15-04	150	75	37
	250	95	53
	350	99	91
	450	99	82
15-05	150	58	37
	250	65	53
	350	80	80
	450	75	68
15-06	150	40	30
	250	75	33
	350	78	43
	450	80	43

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
15-07	150	50	30
	250	75	33
	350	78	53
	450	86	53
15-08	150	47	30
	250	75	33
	350	77	40
	450	80	50
15-09	150	43	33
	250	77	40
	350	78	63
	450	83	50
15-10	150	27	40
	250	77	43
	350	80	50
	450	92	40
15-11	150	37	30
	250	72	33
	350	80	60
	450	95	40
15-12	150	78	37
	250	98	40
	350	99	53
	450	100	50
15-13	150	75	30
	250	88	40
	350	98	47
	450	100	65
15-14	150	73	30
	250	87	40
	350	98	50
	450	99	53
15-15	150	72	30
	250	93	40
	350	96	43
	450	99	50
15-16	150	73	40
	250	83	40
	350	98	40
	450	100	47

Composition 15-04 containing steareth-20 outperformed its counterpart 15-03 containing steareth-10, though both gave greater herbicidal effectiveness, especially on ECHCF, than 15-02 containing laureth-23 or 15-01 containing Neodol 1-12.

EXAMPLE 16

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient

ingredients as shown in Table 16a. Concentrate compositions 16-01 to 16-07 and 16-09 to 16-15 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 16-08 and 16-16 are aqueous solution concentrates and were prepared by process (viii).

Table 16a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
16-01	163	0.5	5.0	methyl stearate	oleth-20
16-02	163	0.5	5.0	butyl stearate	oleth-20
16-03	163	0.5	5.0	methyl oleate	oleth-20
16-04	163	0.5	5.0	butyl oleate	oleth-20
16-05	163	0.5	5.0	methyl laurate	oleth-20
16-06	163	0.5	5.0	butyl laurate	oleth-20
16-07	163	0.5	5.0	Orchex 796	oleth-20
16-08	163		5.0	none	oleth-20
16-09	163	0.5	5.0	methyl stearate	Neodol 1-9
16-10	163	0.5	5.0	butyl stearate	Neodol 1-9
16-11	163	0.5	5.0	methyl oleate	Neodol 1-9
16-12	163	0.5	5.0	butyl oleate	Neodol 1-9
16-13	163	0.5	5.0	methyl laurate	Neodol 1-9
16-14	163	0.5	5.0	butyl laurate	Neodol 1-9
16-15	163	0.5	5.0	Orchex 796	Neodol 1-9
16-16	163		5.0	none	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 16b.

Table 16b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	3	10
	250	58	57
	350	78	53
	450	77	53
Formulation C	150	60	98
	250	87	99
	350	95	98
	450	99	100
Formulation J	150	60	75
	250	89	87
	350	93	90
	450	98	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
16-01	150	75	96
	250	99	97
	350	97	99
	450	99	100
16-02	150	60	60
	250	97	67
	350	99	98
	450	100	95
16-03	150	63	40
	250	83	82
	350	97	86
	450	97	88
16-04	150	73	40
	250	94	82
	350	97	100
	450	99	100
16-05	150	67	47
	250	86	67
	350	97	88
	450	99	100
16-06	150	60	43
	250	78	91
	350	97	83
	450	94	86
16-07	150	70	53
	250	80	53
	350	97	82
	450	97	92
16-08	150	70	62
	250	83	83
	350	91	87
	450	98	98
16-09	150	45	42
	250	72	72
	350	77	73
	450	78	89
16-10	150	40	30
	250	82	80
	350	78	98
	450	89	93
16-11	150	40	30
	250	65	60
	350	77	90
	450	96	92
16-12	150	20	30
	250	63	73
	350	80	75
	450	93	86

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
16-13	150	20	27
	250	67	60
	350	82	91
	450	88	92
16-14	150	7	30
	250	72	81
	350	87	78
	450	80	85
16-15	150	20	23
	250	65	60
	350	77	81
	450	87	88
16-16	150	12	30
	250	57	53
	350	68	85
	450	85	85

Composition 16-08, containing as sole excipient substance oleth-20 at a 1:3 weight/weight ratio to glyphosate a.e., exhibited high herbicidal effectiveness, at least equal to commercial standard Formulations C and J on ABUTH but a little weaker on ECHCF. By comparison, composition 16-16, wherein the sole excipient substance was Neodol 1-9 at the same ratio to glyphosate, had much weaker activity. Addition of a small amount of fatty acid ester in most cases enhanced effectiveness, especially on ECHCF. In this study the most efficacious composition was 16-01, containing oleth-20 and methyl stearate. When added to Neodol 1-9, butyl stearate was more efficacious than methyl stearate, methyl oleate or butyl oleate. The mineral oil Orchex 796 did not substitute effectively for butyl stearate, either with oleth-20 or with Neodol 1-9.

EXAMPLE 17

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 17a. Concentrate compositions 17-01, 17-03, 17-05 to 17-08, 17-10 and 17-14 to 17-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 17-02, 17-04, 17-09 and 17-11 to 17-13 are aqueous solution concentrates and were prepared by process (viii). Some compositions contained a coupling agent as indicated in Table 17a; the coupling agent was added with the surfactant.

Table 17a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of coupling agent	Type of surfactant
		Butyl stearate	Surfactant	Coupling agent		
17-01	326	1.0	5.0	2.5	Arcosolve DPM	oleth-20
17-02	326		5.0	2.5	Arcosolve DPM	oleth-20
17-03	163	0.5	2.5		none	oleth-20
17-04	163		2.5		none	oleth-20

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of coupling agent	Type of surfactant
		Butyl stearate	Surfactant	Coupling agent		
17-05	326	1.0	5.0		none	ceteareth-27
17-06	326	1.0	5.0	2.5	PEG-400	ceteareth-27
17-07	326	1.0	5.0	2.5	Dowanol TPNB	ceteareth-27
17-08	326	1.0	5.0	2.5	Dowanol PNB	ceteareth-27
17-09	163		2.5		none	ceteareth-27
17-10	326	0.5	5.0		none	ceteareth-27
17-11	326		5.0	2.5	PEG-400	ceteareth-27
17-12	326		5.0	2.5	Dowanol TPNB	ceteareth-27
17-13	326		5.0	2.5	Dowanol PNB	ceteareth-27
17-14	163	0.5	2.5		none	Neodol 1-9
17-15	163	0.5	2.5		none	laureth-23
17-16	163	0.5	2.5		none	steareth-20
17-17	163	0.5	2.5		none	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 17b.

Table 17b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	5
	250	38	20
	350	63	30
	450	70	70
Formulation C	150	70	75
	250	92	94
	350	99	99
	450	99	98
Formulation J	150	65	50
	250	88	92
	350	97	99
	450	98	97
17-01	150	58	83
	250	77	88
	350	93	96
	450	93	99
17-02	150	40	76
	250	75	100
	350	92	100
	450	92	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
17-03	150	48	75
	250	83	96
	350	92	100
	450	99	100
17-04	150	40	82
	250	78	99
	350	87	99
	450	98	100
17-05	150	68	92
	250	87	99
	350	95	99
	450	99	99
17-06	150	55	60
	250	83	99
	350	97	99
	450	98	98
17-07	150	63	57
	250	80	96
	350	95	97
	450	99	98
17-08	150	73	75
	250	90	90
	350	95	97
	450	100	97
17-09	150	73	68
	250	87	73
	350	92	90
	450	97	95
17-10	150	70	63
	250	87	80
	350	98	94
	450	99	96
17-11	150	73	60
	250	90	77
	350	99	93
	450	100	95
17-12	150	72	67
	250	83	75
	350	90	82
	450	99	94
17-13	150	73	70
	250	80	83
	350	99	94
	450	100	92
17-14	150	5	20
	250	55	63
	350	77	93
	450	78	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
17-15	150	43	57
	250	78	88
	350	88	98
	450	90	98
17-16	150	65	57
	250	83	82
	350	88	98
	450	95	97
17-17	150	72	50
	250	80	93
	350	88	90
	450	95	97

The superiority of herbicidal effectiveness provided by C_{16-18} alkylethers (oleth-20, ceteareth-27, steareth-20) over that provided by shorter chain alkylethers (Neodol 1-9, laureth-23) was very pronounced in this test.

EXAMPLE 18

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 18a. Concentrate compositions 18-01 to 18-07 and 18-09 to 18-15 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 18-08 and 18-16 are aqueous solution concentrates and were prepared by process (viii).

Table 18a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
18-01	163	0.5	5.0	methyl stearate	steareth-20
18-02	163	0.5	5.0	butyl stearate	steareth-20
18-03	163	0.5	5.0	methyl oleate	steareth-20
18-04	163	0.5	5.0	butyl oleate	steareth-20
18-05	163	0.5	5.0	methyl laurate	steareth-20
18-06	163	0.5	5.0	butyl laurate	steareth-20
18-07	163	0.5	5.0	Orchex 796	steareth-20
18-08	163		5.0	none	steareth-20
18-09	163	0.5	5.0	methyl stearate	ceteareth-27
18-10	163	0.5	5.0	butyl stearate	ceteareth-27
18-11	163	0.5	5.0	methyl oleate	ceteareth-27
18-12	163	0.5	5.0	butyl oleate	ceteareth-27
18-13	163	0.5	5.0	methyl laurate	ceteareth-27
18-14	163	0.5	5.0	butyl laurate	ceteareth-27
18-15	163	0.5	5.0	Orchex 796	ceteareth-27
18-16	163		5.0	none	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray

compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 18b.

Table 18b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	15	5
	250	57	20
	350	83	50
	450	78	73
Formulation C	150	65	63
	250	87	93
	350	92	94
	450	98	100
Formulation J	150	50	73
	250	90	90
	350	94	98
	450	98	99
18-01	150	72	70
	250	88	85
	350	96	83
	450	99	86
18-02	150	73	53
	250	83	87
	350	97	99
	450	97	98
18-03	150	68	33
	250	87	92
	350	93	97
	450	98	93
18-04	150	72	50
	250	87	88
	350	94	86
	450	98	97
18-05	150	72	67
	250	83	82
	350	99	97
	450	98	98
18-06	150	73	33
	250	95	83
	350	99	95
	450	99	88
18-07	150	73	55
	250	93	73
	350	95	83
	450	98	91

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
18-08	150	75	40
	250	94	60
	350	98	86
	450	99	92
18-09	150	77	50
	250	90	50
	350	98	92
	450	99	98
18-10	150	72	53
	250	92	77
	350	96	86
	450	99	99
18-11	150	72	60
	250	87	87
	350	97	97
	450	97	99
18-12	150	70	57
	250	90	90
	350	96	96
	450	98	99
18-13	150	68	40
	250	90	77
	350	99	95
	450	99	98
18-14	150	77	33
	250	94	70
	350	96	82
	450	99	93
18-15	150	75	30
	250	96	75
	350	97	88
	450	99	92
18-16	150	77	40
	250	99	47
	350	98	67
	450	98	78

Steareth-20 and ceteareth-27, as sole excipient substances (compositions 18-08 and 18-16 respectively) provided excellent herbicidal effectiveness, but further enhancements, especially on ECHCF, were obtained by inclusion of a small amount of fatty acid ester in the composition.

EXAMPLE 19

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 19a. Concentrate compositions 19-13 and 19-14 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 19-01 to 19-12 and 19-15

are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 19-16 and 19-17 contained colloidal particulates but no surfactant.

Compositions 19-13 and 19-14 (both containing 162 g a.e./l glyphosate) showed acceptable storage stability. However, at glyphosate loadings >480 g a.e./l (as in compositions 19-01 to 19-12 and 19-15) storage-stable compositions containing 3% oleth-20 could not be made except with the addition of colloidal particulate as shown below.

Table 19a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Oleth-20	Glycerin	Aerosil	
19-01	492	3.00	2.0	0.8	380
19-02	492	3.00	5.0	1.5	380
19-03	492	3.00	2.0	0.8	380
19-04	492	3.00	5.0	1.5	380
19-05	492	3.00		0.8	OX-50
19-06	492	3.00		1.5	OX-50
19-07	492	3.00		0.8	380/OX-50 blend
19-08	492	3.00		1.5	380/OX-50 blend
19-09	492	3.00		0.8	380
19-10	492	3.00		1.5	380
19-11	492	3.00		0.8	380
19-12	492	3.00		1.5	380
19-13	162	1.13			none
19-14	162	1.13			none
19-15	492	3.00	2.0	1.5	380
19-16	488			0.8	380
19-17	488			1.5	380

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 19b.

Table 19b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	18	40
	250	57	53
	350	72	63
	450	83	85
Formulation J	150	70	65
	250	85	95
	350	98	98
	450	100	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
19-01	150	62	67
	250	72	93
	350	99	96
	450	99	97
19-02	150	57	50
	250	70	91
	350	92	97
	450	99	99
19-03	150	48	40
	250	68	67
	350	97	97
	450	98	98
19-04	150	55	50
	250	82	83
	350	95	90
	450	99	94
19-05	150	65	43
	250	87	87
	350	100	94
	450	96	95
19-06	150	55	53
	250	75	82
	350	95	95
	450	100	96
19-07	150	45	83
	250	78	82
	350	90	93
	450	95	99
19-08	150	55	47
	250	75	88
	350	93	99
	450	99	97
19-09	150	47	47
	250	65	82
	350	78	99
	450	97	97
19-10	150	47	40
	250	72	96
	350	77	80
	450	85	97
19-11	150	37	53
	250	73	82
	350	80	83
	450	90	92
19-12	150	35	57
	250	70	82
	350	80	97
	450	90	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
19-13	150	50	40
	250	68	75
	350	95	92
	450	99	95
19-14	150	40	33
	250	70	82
	350	93	89
	450	98	93
19-15	150	23	33
	250	67	73
	350	83	91
	450	94	92
19-16	150	13	40
	250	45	50
	350	62	72
	450	77	77
19-17	150	7	33
	250	50	50
	350	60	70
	450	75	73

Several high-loaded (492 g a.e./l) glyphosate compositions containing oleth-20 at just 3% exhibited surprisingly high herbicidal effectiveness, approaching or equalling that of commercial standard Formulation J, which is loaded at only about 360 g a.e./l and has a much higher surfactant to glyphosate ratio.

EXAMPLE 20

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 20a. Concentrate composition 20-08 to 20-14 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 20-15 to 20-17 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 20-01 to 20-07 contain colloidal particulates and were prepared by process (ix).

Compositions 20-08 to 20-17 (all containing 163 g a.e./l glyphosate) showed acceptable storage stability. However, at a glyphosate loading of 400 g a.e./l (as in compositions 20-01 to 20-07) storage-stable compositions containing 0.5-1% butyl stearate and 5-10% alkylether surfactant could not be made except with the addition of colloidal particulate as shown below.

Table 20a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant
		Butyl stearate	Surfactant	Aerosil 90	
20-01	400	1.0	10.0	1.0	ceteareth-27
20-02	400	1.0	10.0	1.0	steareth-20

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant
		Butyl stearate	Surfactant	Aerosil 90	
20-03	400	0.5	5.0	1.0	ceteareth-27
20-04	400	0.5	5.0	1.0	steareth-20
20-05	400	1.0	5.0	1.0	ceteareth-27
20-06	400	1.0	5.0	1.0	steareth-20
20-07	400	1.0	5.0	1.0	steareth-30
20-08	163	0.5	5.0		oleth-20
20-09	163	0.5	5.0		steareth-20
20-10	163	0.5	5.0		ceteth-20
20-11	163	0.5	5.0		laureth-23
20-12	163	0.5	5.0		ceteareth-27
20-13	163	0.5	5.0		Neodol 25-12
20-14	163	0.5	5.0		Neodol 25-20
20-15	163		5.0		steareth-20
20-16	163		5.0		ceteth-20
20-17	163		5.0		laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 20b.

Table 20b

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	40
	250	20	60
	350	68	82
	450	83	96
Formulation C	150	68	93
	250	93	99
	350	100	100
	450	100	100
Formulation J	150	43	89
	250	93	100
	350	100	100
	450	100	100
20-01	150	78	97
	250	96	100
	350	98	100
	450	100	100

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
20-02	150	91	98
	250	100	100
	350	100	100
	450	100	100
20-03	150	90	97
	250	99	99
	350	100	100
	450	100	100
20-04	150	77	98
	250	100	100
	350	100	100
	450	100	100
20-05	150	82	93
	250	100	99
	350	100	100
	450	100	100
20-06	150	83	85
	250	100	99
	350	100	100
	450	100	100
20-07	150	83	87
	250	100	100
	350	100	100
	450	100	100
20-08	150	90	92
	250	100	100
	350	100	100
	450	100	100
20-09	150	90	85
	250	100	98
	350	100	100
	450	100	100
20-10	150	80	85
	250	100	92
	350	100	100
	450	100	100
20-11	150	83	88
	250	96	99
	350	100	98
	450	100	100
20-12	150	93	85
	250	100	99
	350	100	100
	450	100	100
20-13	150	72	73
	250	92	97
	350	100	99
	450	100	100

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
20-14	150	72	80
	250	99	99
	350	100	100
	450	100	100
20-15	150	100	93
	250	100	99
	350	100	100
	450	100	100
20-16	150	100	98
	250	100	100
	350	100	100
	450	100	100
20-17	150	83	83
	250	100	99
	350	100	99
	450	100	99

Outstanding herbicidal effectiveness was provided by compositions containing C_{16-18} alkylether surfactants (ceteareth-27, steareth-20, steareth-30, oleth-20, ceteth-20). High-loaded (400 g a.e./l) glyphosate compositions containing a C_{16-18} alkylether surfactant, butyl stearate and a colloidal particulate (Aerosil 90) to stabilize the compositions performed especially impressively in this test.

EXAMPLE 21

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 21a. Concentrate composition 21-01 to 21-09, 21-11 to 21-14, 21-16 and 21-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 21-10 and 21-15 are aqueous solution concentrates and were prepared by process (viii).

Table 21a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
21-01	163	0.25	2.5		methyl laurate	
21-02	163	0.25	2.5		methyl myristate	
21-03	163	0.25	2.5		methyl palmitoleate	
21-04	163	0.25	2.5		methyl palmitate	
21-05	163	0.25	2.5		methyl linoleate	
21-06	163	0.25	2.5		methyl oleate	
21-07	163	0.25	2.5		methyl stearate	
21-08	163	0.25	2.5		ethyl stearate	
21-09	163	0.25	2.5		butyl stearate	
21-10	163		2.5		none	
21-11	163	0.25		2.5	methyl palmitoleate	MON 0818
21-12	163	0.25		2.5	methyl palmitate	MON 0818
21-13	163	0.25		2.5	methyl oleate	MON 0818
21-14	163	0.25		2.5	methyl stearate	MON 0818

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
21-15	163			2.5	none	MON 0818
21-16	163	0.25		2.5	butyl stearate	laureth-23
21-17	163	0.25		2.5	butyl stearate	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 21b.

Table 21b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	35
	200	52	67
	300	77	83
	400	78	87
Formulation C	100	25	77
	200	72	99
	300	87	100
	400	99	100
Formulation J	100	13	73
	200	70	97
	300	90	100
	400	97	100
21-01	100	22	55
	200	65	86
	300	78	98
	400	89	98
21-02	100	20	63
	200	67	91
	300	83	99
	400	97	100
21-03	100	30	75
	200	63	98
	300	83	99
	400	94	100
21-04	100	23	63
	200	60	98
	300	90	99
	400	95	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
21-05	100	27	57
	200	62	91
	300	83	96
	400	93	98
21-06	100	23	50
	200	63	89
	300	83	99
	400	96	99
21-07	100	25	53
	200	65	94
	300	83	99
	400	92	99
21-08	100	13	47
	200	53	88
	300	89	97
	400	95	99
21-09	100	27	53
	200	60	85
	300	83	97
	400	97	98
21-10	100	13	53
	200	62	94
	300	83	97
	400	88	99
21-11	100	23	60
	200	50	90
	300	85	98
	400	95	99
21-12	100	17	55
	200	35	94
	300	78	98
	400	94	99
21-13	100	8	50
	200	43	90
	300	73	98
	400	90	99
21-14	100	30	63
	200	45	92
	300	80	98
	400	94	98
21-15	100	20	63
	200	70	96
	300	82	99
	400	94	98
21-16	100	18	62
	200	62	83
	300	80	97
	400	97	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
21-17	100	17	52
	200	58	85
	300	75	90
	400	95	98

No great or consistent enhancement of herbicidal effectiveness of glyphosate compositions containing oleth-20 was obtained by adding a small amount of any of a variety of fatty acid esters in this study (compare 21-10 with 21-01 to 21-09).

EXAMPLE 22

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 22a. Concentrate composition 22-01 to 22-09, 22-11 to 22-14, 22-16 and 22-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 22-10 and 22-15 are aqueous solution concentrates and were prepared by process (viii).

Table 22a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
22-01	163	0.25	2.5		isopropyl myristate	
22-02	163	0.25	2.5		ethyl myristate	
22-03	163	0.25	2.5		methyl palmitate	
22-04	163	0.25	2.5		ethyl palmitate	
22-05	163	0.25	2.5		ethyl linoleate	
22-06	163	0.25	2.5		ethyl oleate	
22-07	163	0.25	2.5		methyl stearate	
22-08	163	0.25	2.5		ethyl stearate	
22-09	163	0.25	2.5		butyl stearate	
22-10	163		2.5		none	
22-11	163	0.25		2.5	methyl palmitate	MON 0818
22-12	163	0.25		2.5	methyl stearate	MON 0818
22-13	163	0.25		2.5	ethyl stearate	MON 0818
22-14	163	0.25		2.5	ethyl oleate	MON 0818
22-15	163			2.5	none	MON 0818
22-16	163	0.25		2.5	butyl stearate	laureth-23
22-17	163	0.25		2.5	butyl stearate	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 22b.

Table 22b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	12	33
	200	45	43
	300	73	63
	400	80	63
Formulation C	100	43	57
	200	75	88
	300	95	99
	400	100	99
Formulation J	100	53	60
	200	77	75
	300	96	95
	400	99	98
22-01	100	35	40
	200	73	72
	300	83	91
	400	99	97
22-02	100	38	30
	200	70	43
	300	87	82
	400	96	80
22-03	100	25	27
	200	68	50
	300	90	73
	400	96	82
22-04	100	27	27
	200	75	50
	300	80	73
	400	96	80
22-05	100	33	27
	200	68	43
	300	83	70
	400	97	91
22-06	100	33	28
	200	72	53
	300	83	60
	400	99	70
22-07	100	37	25
	200	72	40
	300	83	50
	400	97	65
22-08	100	32	25
	200	73	43
	300	87	60
	400	98	67

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
22-09	100	35	25
	200	75	43
	300	95	57
	400	98	63
22-10	100	35	27
	200	73	40
	300	83	76
	400	97	73
22-11	100	35	33
	200	67	67
	300	80	86
	400	92	70
22-12	100	25	30
	200	67	70
	300	83	76
	400	88	80
22-13	100	27	33
	200	70	66
	300	78	63
	400	93	60
22-14	100	33	30
	200	67	47
	300	80	70
	400	92	77
22-15	100	20	30
	200	68	40
	300	83	75
	400	90	72
22-16	100	30	25
	200	62	43
	300	73	73
	400	77	70
22-17	100	30	23
	200	58	40
	300	75	60
	400	80	73

In this study, isopropyl myristate (composition 22-01) was the most effective of the fatty acid esters tested as additives to oleth-20 (22-10) in glyphosate compositions.

EXAMPLE 23

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 23a. Concentrate composition 23-01 to 23-13 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 23-14 to 23-17 are aqueous solution concentrates and were prepared by process (viii).

Table 23a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
23-01	163	0.25	2.5	butyl stearate	laureth-23
23-02	163	0.25	2.5	butyl stearate	steareth-20
23-03	163	0.25	2.5	butyl stearate	ceteareth-20
23-04	163	0.25	2.5	butyl stearate	ceteareth-15
23-05	163	0.25	2.5	butyl stearate	Neodol 45-13
23-06	163	0.25	2.5	methyl stearate	steareth-20
23-07	163	0.25	2.5	methyl stearate	ceteareth-20
23-08	163	0.25	2.5	methyl stearate	ceteareth-15
23-09	163	0.25	2.5	methyl stearate	Neodol 45-13
23-10	163	0.25	2.5	methyl palmitate	steareth-20
23-11	163	0.25	2.5	methyl palmitate	ceteareth-20
23-12	163	0.25	2.5	methyl palmitate	ceteareth-15
23-13	163	0.25	2.5	methyl palmitate	Neodol 45-13
23-14	163		2.5	none	steareth-20
23-15	163		2.5	none	ceteareth-20
23-16	163		2.5	none	ceteareth-15
23-17	163		2.5	none	Neodol 45-13

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 24 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 23b.

Table 23b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	10	37
	200	30	40
	300	43	57
	400	23	33
Formulation C	100	50	67
	200	75	96
	300	85	99
	400	94	100
Formulation J	100	40	75
	200	73	94
	300	93	98
	400	95	99
23-01	100	63	77
	200	67	94
	300	77	99
	400	88	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
23-02	100	63	75
	200	83	88
	300	93	98
	400	95	99
23-03	100	67	75
	200	82	95
	300	95	99
	400	98	99
23-04	100	60	75
	200	82	97
	300	96	99
	400	98	100
23-05	100	63	73
	200	75	89
	300	80	98
	400	87	97
23-06	100	58	63
	200	78	93
	300	93	99.
	400	98	100
23-07	100	60	67
	200	78	93
	300	93	99
	400	100	99
23-08	100	missing	missing
	200	missing	missing
	300	78	95
	400	98	99
23-09	100	23	30
	200	65	83
	300	80	98
	400	93	99
23-10	100	65	67
	200	83	95
	300	97	99
	400	99	99
23-11	100	72	73
	200	90	98
	300	96	97
	400	99	99
23-12	100	68	63
	200	90	92
	300	98	99
	400	97	99
23-13	100	43	73
	200	72	87
	300	83	98
	400	93	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
23-14	100	62	77
	200	78	99
	300	95	99
	400	98	100
23-15	100	52	60
	200	78	93
	300	94	98
	400	97	99
23-16	100	38	68
	200	68	99
	300	87	97
	400	94	99
23-17	100	55	75
	200	68	91
	300	83	96
	400	87	98

Herbicidal effectiveness exceeding that of commercial standard composition J, at least on ABUTH, was recorded with several compositions, including 23-02 (steareth-20 plus butyl stearate), 23-03 (ceteareth-20 plus butyl stearate), 23-04 (ceteareth-15 plus butyl stearate), 23-10 (steareth-20 plus methyl palmitate), 23-11 (ceteareth-20 plus methyl palmitate) and 23-12 (ceteareth-15 plus methyl palmitate). Compositions lacking fatty acid ester performed slightly less well overall than those containing butyl stearate or methyl palmitate.

EXAMPLE 24

Spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 24a. Compositions were prepared by simple mixing of ingredients. Soybean lecithin (45% phospholipid, Avanti), where included, was first prepared with sonication in water to make a homogeneous composition. Four different concentrations of glyphosate (not shown in Table 24a) were prepared, calculated to provide, when applied in a spray volume of 93 l/ha, the glyphosate rates shown in Table 24b.

Table 24a

Spray comp.	% w/w					Lecithin supplied as	Methyl oleate supplied as
	Lecithin	FC-754	Butyl stearate	Methyl oleate	Oleth-20		
24-01	0.05	0.050				soybean lecithin	
24-02	0.05		0.050			soybean lecithin	
24-03	0.05					soybean lecithin	
24-04		0.050					
24-05			0.050				
24-06	0.05					LI-700	
24-07			0.005		0.05		
24-08				0.01	0.05		

Spray comp.	% w/w					Lecithin supplied as	Methyl oleate supplied as
	Lecithin	FC-754	Butyl stearate	Methyl oleate	Oleth-20		
24-09					0.05		
24-10			0.005				
24-11				0.01			pure
24-12				0.01			methylated seed oil

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and Prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 14 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Formulations B and C were applied as comparative treatments, representing technical glyphosate IPA salt and a commercial formulation of glyphosate IPA salt respectively. Results, averaged for all replicates of each treatment, are shown in Table 24b.

Table 24b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	50	0	0	0
	100	38	35	35
	200	87	50	90
	300	95	88	94
Formulation C	50	0	2	0
	100	32	55	25
	200	85	97	93
	300	96	99	96
24-01	50	78	53	88
	100	90	60	95
	200	99	96	99
	300	99	97	98
24-02	50	25	15	43
	100	72	30	82
	200	94	62	93
	300	95	77	94
24-03	50	20	8	32
	100	52	22	78
	200	87	55	91
	300	95	65	93
24-04	50	62	37	85
	100	82	68	92
	200	97	96	95
	300	98	95	97

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
24-05	50	15	10	25
	100	47	27	23
	200	85	62	87
	300	90	63	92
24-06	50	0	2	0
	100	20	15	20
	200	85	60	82
	300	90	65	90
24-07	50	67	27	82
	100	87	55	93
	200	94	92	96
	300	97	99	97
24-08	50	62	30	75
	100	78	63	91
	200	93	96	96
	300	94	98	98
24-09	50	65	45	77
	100	80	73	95
	200	93	98	97
	300	95	99	99
24-10	50	10	25	5
	100	23	35	37
	200	90	50	93
	300	92	73	94
24-11	50	10	25	0
	100	52	33	43
	200	88	72	93
	300	94	78	94
24-12	50	0	15	0
	100	43	35	33
	200	91	70	90
	300	94	82	93

Results of this test using glyphosate as the exogenous chemical are summarized as follows: Oleth-20 at the low concentration of 0.05% (24-09) gave extremely high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (24-07) or 0.01% methyl oleate (24-08) did not provide further enhancement.

EXAMPLE 25

Spray compositions were prepared containing paraquat dichloride and excipient ingredients. Compositions 25-01 to 25-12 were exactly like compositions 24-01 to 24-12 except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 12 days after application.

Standards included technical paraquat dichloride and Gramoxone, a commercial formulation of paraquat from Zeneca. Results, averaged for all replicates of each treatment, are shown in Table 25.

Table 25

Spray composition	Paraquat rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Paraquat dichloride (technical)	25	50	83	55
	50	57	78	60
	100	73	84	69
	200	85	95	99
Gramoxone (commercial)	25	40	72	40
	50	60	70	52
	100	72	58	55
	200	72	89	63
25-01	25	75	93	67
	50	82	97	91
	100	95	98	97
	200	100	99	99
25-02	25	67	80	48
	50	68	87	65
	100	88	97	93
	200	96	99	98
25-03	25	55	65	42
	50	62	87	65
	100	83	96	93
	200	95	99	97
25-04	25	53	82	45
	50	63	94	53
	100	88	99	86
	200	92	99	98
25-05	25	58	67	50
	50	60	62	45
	100	70	73	62
	200	85	90	88
25-06	25	53	77	43
	50	60	92	40
	100	80	93	55
	200	96	99	78
25-07	25	65	80	45
	50	82	92	70
	100	96	96	89
	200	100	98	99

Spray composition	Paraquat rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
25-08	25	67	80	37
	50	82	90	71
	100	97	98	65
	200	99	99	93
25-09	25	72	90	50
	50	80	97	57
	100	91	99	94
	200	97	100	97
25-10	25	67	87	45
	50	68	75	57
	100	78	93	63
	200	82	97	82
25-11	25	65	80	45
	50	73	77	62
	100	90	95	62
	200	94	98	78
25-12	25	67	78	37
	50	75	90	55
	100	77	97	90
	200	85	99	92

Results of this test using paraquat as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (25-09) gave extremely high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (25-07) or 0.01% methyl oleate (25-08) did not provide further enhancement.

EXAMPLE 26

Spray compositions were prepared containing acifluorfen sodium salt and excipient ingredients. Compositions 26-01 to 26-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH, 9 days after planting ECHCF and 22 days after planting SIDSP. Evaluation of herbicidal inhibition was done 10 days after application.

Standards included technical acifluorfen sodium and Blazer, a commercial formulation of acifluorfen from Rohm & Haas. Results, averaged for all replicates of each treatment, are shown in Table 26.

Table 26

Spray composition	Acifluorfen rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Acifluorfen (technical)	25	20	2	15
	50	32	7	17
	100	52	18	35
	200	62	35	40
Blazer (commercial)	25	30	30	5
	50	53	53	12
	100	55	55	7
	200	65	65	32
26-01	25	60	7	20
	50	63	20	20
	100	65	43	33
	200	80	70	48
26-02	25	25	7	5
	50	42	12	25
	100	60	30	22
	200	68	68	50
26-03	25	22	5	10
	50	55	7	33
	100	62	25	27
	200	65	55	48
26-04	25	57	7	13
	50	67	10	32
	100	67	35	32
	200	70	70	45
26-05	25	30	3	15
	50	47	27	27
	100	55	42	37
	200	65	60	38
26-06	25	28	0	3
	50	50	0	10
	100	55	30	25
	200	67	58	47
26-07	25	35	20	17
	50	55	35	27
	100	58	63	32
	200	67	67	55
26-08	25	40	20	8
	50	57	30	28
	100	60	60	30
	200	70	77	48
26-09	25	47	20	22
	50	55	35	35
	100	62	65	38
	200	68	82	50

Spray composition	Acifluorfen rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
26-10	25	28	0	5
	50	48	0	10
	100	53	5	25
	200	62	35	40
26-11	25	35	0	5
	50	43	0	30
	100	50	0	35
	200	65	43	47
26-12	25	40	5	5
	50	55	18	35
	100	60	47	38
	200	70	62	48

Results of this test using acifluorfen as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (26-09) gave effectiveness superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (26-07) or 0.01% methyl oleate (26-08) did not provide further enhancement.

EXAMPLE 27

Spray compositions were prepared containing asulam and excipient ingredients. Compositions 27-01 to 27-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 11 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical asulam and Asulox, a commercial formulation of asulam from Rhône-Poulenc. Results, averaged for all replicates of each treatment, are shown in Table 27.

Table 27

Spray composition	Asulam rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Asulam (technical)	200	0	12	0
	400	17	27	5
	800	48	32	20
	1400	42	50	37
Asulox (commercial)	200	3	5	0
	400	27	30	20
	800	52	45	25
	1400	50	60	40

Spray composition	Asulam rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
27-01	200	5	8	13
	400	23	45	22
	800	50	50	30
	1400	60	65	48
27-02	200	0	20	17
	400	33	40	20
	800	47	48	33
	1400	53	68	55
27-03	200	3	20	3
	400	28	52	7
	800	50	50	23
	1400	50	58	43
27-04	200	3	40	7
	400	35	45	18
	800	52	50	25
	1400	58	60	42
27-05	200	0	10	3
	400	23	30	18
	800	33	50	32
	1400	45	57	38
27-06	200	2	30	10
	400	8	47	17
	800	50	55	28
	1400	52	63	40
27-07	200	0	43	3
	400	22	48	17
	800	40	55	28
	1400	52	60	33
27-08	200	7	47	22
	400	20	48	22
	800	53	55	30
	1400	57	60	33
27-09	200	0	45	7
	400	25	50	7
	800	53	60	32
	1400	55	63	37
27-10	200	22	37	10
	400	27	45	10
	800	50	43	23
	1400	52	52	27
27-11	200	25	33	5
	400	15	37	13
	800	48	42	25
	1400	42	52	28
27-12	200	3	25	17
	400	13	42	18
	800	50	45	30
	1400	52	50	33

Results of this test using asulam as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (27-09) gave, at low exogenous chemical rates, effectiveness on ECHCF superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (27-07) or 0.01% methyl oleate (27-08) did not provide further enhancement.

EXAMPLE 28

Spray compositions were prepared containing dicamba sodium salt and excipient ingredients. Compositions 28-01 to 28-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 17 days after application.

Standards included technical dicamba sodium and Banvel, a commercial formulation of dicamba from Sandoz. Results, averaged for all replicates of each treatment, are shown in Table 28.

Table 28

Spray composition	Dicamba rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Dicamba (technical)	25	47	0	30
	50	63	0	40
	100	82	0	50
	200	93	5	58
Banvel (commercial)	25	47	0	35
	50	68	0	40
	100	91	0	53
	200	93	3	63
28-01	25	42	0	38
	50	67	0	48
	100	92	0	67
	200	93	3	73
28-02	25	43	0	43
	50	58	0	50
	100	85	0	62
	200	89	8	72
28-03	25	50	0	32
	50	65	0	45
	100	90	0	60
	200	94	13	68

Spray composition	Dicamba rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
28-04	25	43	0	35
	50	65	0	42
	100	94	0	53
	200	94	13	67
28-05	25	50	0	35
	50	68	0	40
	100	88	0	53
	200	92	15	60
28-06	25	40	0	40
	50	65	0	45
	100	88	0	52
	200	92	8	70
28-07	25	45	0	42
	50	57	0	45
	100	88	0	62
	200	88	20	68
28-08	25	40	0	38
	50	62	0	45
	100	97	18	62
	200	93	17	73
28-09	25	33	0	35
	50	60	0	45
	100	93	0	63
	200	96	15	73
28-10	25	35	0	30
	50	57	0	43
	100	90	0	50
	200	90	3	70
28-11	25	45	0	30
	50	53	0	42
	100	89	0	55
	200	92	0	73
28-12	25	38	0	37
	50	60	0	45
	100	96	0	52
	200	93	0	70

Results of this test using dicamba as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (28-09) gave effectiveness on SIDSP superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (28-07) or 0.01% methyl oleate (28-08) did not provide significant further enhancement.

EXAMPLE 29

Spray compositions were prepared containing metsulfuron-methyl and excipient ingredients. Compositions 29-01 to 29-12 were exactly like compositions 24-01 to 24-12 respectively except that a

different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical metsulfuron-methyl and Ally, a commercial formulation of metsulfuron from Du Pont. Results, averaged for all replicates of each treatment, are shown in Table 29.

Table 29

Spray composition	Metsulfuron rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Metsulfuron (technical)	0.5	72	0	5
	1	90	0	23
	5	96	0	50
	10	97	30	55
Ally (commercial)	0.5	75	0	5
	1	85	0	22
	5	95	0	42
	10	97	25	53
29-01	0.5	95	0	47
	1	96	20	53
	5	97	25	62
	10	98	45	62
29-02	0.5	87	0	40
	1	90	10	55
	5	95	10	58
	10	96	40	63
29-03	0.5	87	0	27
	1	90	0	40
	5	96	10	57
	10	97	33	63
29-04	0.5	90	0	33
	1	95	10	50
	5	98	17	62
	10	99	28	58
29-05	0.5	85	0	27
	1	90	0	33
	5	95	0	47
	10	95	13	60
29-06	0.5	77	0	30
	1	89	10	47
	5	96	17	62
	10	98	33	60

Spray composition	Metsulfuron rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
29-07	0.5	94	0	55
	1	97	10	60
	5	98	43	60
	10	97	55	65
29-08	0.5	93	0	55
	1	96	5	58
	5	97	42	60
	10	97	50	60
29-09	0.5	93	0	55
	1	97	10	62
	5	98	55	62
	10	98	65	63
29-10	0.5	85	0	28
	1	82	0	30
	5	95	10	52
	10	96	17	57
29-11	0.5	73	0	25
	1	88	20	28
	5	94	25	53
	10	96	32	57
29-12	0.5	75	0	32
	1	85	20	37
	5	94	23	55
	10	96	25	57

Results of this test using metsulfuron as the exogenous chemical are summarized as follows: Oleth-20 at the low concentration of 0.05% (29-09) gave high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (29-07) or 0.01% methyl oleate (29-08) did not provide further enhancement.

EXAMPLE 30

Spray compositions were prepared containing imazethapyr and excipient ingredients. Compositions 30-01 to 30-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 14 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical imazethapyr and Pursuit, a commercial formulation of imazethapyr from American Cyanamid. Results, averaged for all replicates of each treatment, are shown in Table 30.

Table 30

Spray composition	Imazethapyr rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Imazethapyr (technical)	5	78	5	20
	10	83	20	30
	25	93	35	40
	50	94	53	50
Pursuit (commercial)	5	70	5	25
	10	73	33	30
	25	90	50	42
	50	93	62	57
30-01	5	70	45	35
	10	75	62	52
	25	92	63	57
	50	93	72	62
30-02	5	73	57	32
	10	75	67	43
	25	90	70	52
	50	92	72	57
30-03	5	70	42	27
	10	78	42	35
	25	90	53	45
	50	92	62	52
30-04	5	73	55	33
	10	77	68	45
	25	93	68	47
	50	94	68	60
30-05	5	73	47	32
	10	73	45	40
	25	90	62	47
	50	91	68	52
30-06	5	78	72	30
	10	83	70	35
	25	93	77	62
	50	94	78	58
30-07	5	82	75	38
	10	90	90	52
	25	93	93	53
	50	97	97	62
30-08	5	75	77	38
	10	90	92	50
	25	95	93	57
	50	97	99	63
30-09	5	78	80	40
	10	83	89	63
	25	93	93	62
	50	96	93	60

Spray composition	Imazethapyr rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
30-10	5	85	50	37
	10	77	50	45
	25	91	63	48
	50	93	75	57
30-11	5	75	38	43
	10	80	38	37
	25	92	62	45
	50	93	73	53
30-12	5	75	55	38
	10	83	60	43
	25	92	67	53
	50	93	77	55

Results of this test using imazethapyr as the exogenous chemical are summarized as follows: Oleth-20 at the low concentration of 0.05% (30-09) gave extremely high effectiveness, greatly superior to that obtained with the commercial standard, especially on ECHCF. Addition of 0.005% butyl stearate (30-07) further enhanced performance of low exogenous chemical rates on ABUTH more effectively than addition of 0.01% methyl oleate (30-08).

EXAMPLE 31

Spray compositions were prepared containing fluazifop-p-butyl salt and excipient ingredients. Compositions 31-01 to 31-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and broadleaf signalgrass (Brachiaria platyphylla, BRAPP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH, 15 days after planting ECHCF and 16 days after planting BRAPP. Evaluation of herbicidal inhibition was done 10 days after application.

Standards included technical fluazifop-p-butyl and Fusilade 5, a commercial formulation of fluazifop-p-butyl from Zeneca. Results, averaged for all replicates of each treatment, are shown in Table 31.

Table 31

Spray composition	Fluazifop-p rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	BRAPP
Fluazifop-p-butyl (technical)	2	0	0	20
	5	0	3	35
	15	5	45	65
	30	5	57	78

Spray composition	Fluazifop-p rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	BRAPP
Fusilade 5 (commercial)	2	0	0	27
	5	0	27	33
	15	5	52	78
	30	7	75	85
31-01	2	0	0	20
	5	2	27	30
	15	5	58	78
	30	10	87	83
31-02	2	0	7	25
	5	0	35	30
	15	2	58	75
	30	8	78	75
31-03	2	0	0	18
	5	0	8	27
	15	0	45	75
	30	0	55	75
31-04	2	0	20	32
	5	2	42	25
	15	2	55	72
	30	5	80	78
31-05	2	0	13	32
	5	2	42	32
	15	2	55	72
	30	7	58	73
31-06	2	2	17	23
	5	0	20	25
	15	0	50	75
	30	0	73	77
31-07	2	0	50	40
	5	0	52	60
	15	0	67	80
	30	0	92	85
31-08	2	0	43	35
	5	0	55	37
	15	7	88	82
	30	3	96	85
31-09	2	0	47	18
	5	0	50	35
	15	0	80	80
	30	3	93	85
31-10	2	0	23	10
	5	0	37	42
	15	5	55	75
	30	10	58	80
31-11	2	0	7	10
	5	0	30	28
	15	0	50	62
	30	12	53	68

Spray composition	Fluazifop-p rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	BRAPP
31-12	2	0	5	20
	5	0	7	35
	15	5	48	68
	30	12	60	77

Results of this test using fluazifop-p-butyl as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (31-09) gave extremely high effectiveness on ECHCF, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (31-07) or 0.01% methyl oleate (31-08) did not provide significant further enhancement.

EXAMPLE 32

Spray compositions were prepared containing alachlor and excipient ingredients. Compositions 32-01 to 32-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 14 days after planting SIDSP. Evaluation of herbicidal inhibition was done 9 days after application.

Standards included technical alachlor and Lasso, a commercial formulation of alachlor from Monsanto Company. Results, averaged for all replicates of each treatment, are shown in Table 32.

Table 32

Spray composition	Alachlor rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Alachlor (technical)	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
Lasso (commercial)	500	0	0	0
	1000	0	5	13
	2000	0	30	17
	4000	15	43	65
32-01	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	10	0	7

Spray composition	Alachlor rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
32-02	500	0	0	0
	1000	0	0	0
	2000	0	22	7
	4000	12	47	12
32-03	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	10	0	0
32-04	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	5	0	15
32-05	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	3	0	5
32-06	500	0	0	0
	1000	0	0	0
	2000	0	13	7
	4000	0	37	12
32-07	500	0	0	0
	1000	0	8	0
	2000	0	28	15
	4000	12	50	20
32-08	500	0	0	0
	1000	0	8	0
	2000	0	8	0
	4000	5	20	5
32-09	500	0	0	0
	1000	0	0	0
	2000	0	3	0
	4000	12	42	32
32-10	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
32-11	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
32-12	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0

None of the compositions tested enhanced post-emergence foliar-applied herbicidal effectiveness of alachlor in this test. Alachlor is not known as a foliar-applied herbicide.

EXAMPLE 33

Spray compositions were prepared containing glufosinate ammonium salt and excipient ingredients. Compositions 33-01 to 33-12 were exactly like compositions 24-01 to 24-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 10 days after planting ECHCF and 17 days after planting SIDSP. Evaluation of herbicidal inhibition was done 11 days after application.

Standards included technical glufosinate ammonium and Liberty, a commercial formulation of glufosinate from AgrEvo. Results, averaged for all replicates of each treatment, are shown in Table 33.

Table 33

Spray composition	Glufosinate rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Glufosinate (technical)	50	0	0	5
	100	47	0	10
	300	90	23	96
	600	98	43	94
Liberty (commercial)	50	77	70	20
	100	88	96	93
	300	98	100	97
	600	99	100	99
33-01	50	77	33	70
	100	95	58	93
	300	98	95	97
	600	99	99	98
33-02	50	33	30	50
	100	63	32	93
	300	96	52	90
	600	98	96	97
33-03	50	15	30	38
	100	50	33	87
	300	92	40	94
	600	98	70	98
33-04	50	92	47	50
	100	90	53	85
	300	98	98	96
	600	98	99	98
33-05	50	35	20	20
	100	37	30	20
	300	97	45	78
	600	91	53	92

Spray composition	Glufosinate rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
33-06	50	10	0	20
	100	20	3	20
	300	89	47	82
	600	91	94	89
33-07	50	50	35	70
	100	73	52	80
	300	95	87	98
	600	98	98	97
33-08	50	48	30	88
	100	83	50	93
	300	98	97	96
	600	98	99	96
33-09	50	58	35	92
	100	91	62	93
	300	98	96	97
	600	98	99	96
33-10	50	30	30	0
	100	43	35	10
	300	96	43	92
	600	95	70	91
33-11	50	33	35	0
	100	53	35	7
	300	96	43	89
	600	97	88	93
33-12	50	37	5	5
	100	37	20	10
	300	95	40	88
	600	97	85	93

Results of this test using glufosinate as the exogenous chemical are summarized as follows:

Oleth-20 at the low concentration of 0.05% (33-09) gave extremely high effectiveness, superior on SIDSP to that obtained with the commercial standard. Addition of 0.005% butyl stearate (33-07) or 0.01% methyl oleate (33-08) did not provide further enhancement.

EXAMPLE 34

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 34a. Concentrate compositions 34-01 to 34-12 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 34-13 to 34-18 contained colloidal particulates but no surfactant.

The colloidal particulates of this example were in general too large to confer good storage stability to the compositions tested.

Table 34a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant	Type of silica
		Surfactant	Silica		
34-01	488	3.0	0.8	steareth-20	Sident 9
34-02	488	3.0	0.8	steareth-20	Sipernat 22
34-03	488	3.0	0.8	steareth-20	Sipernat 22S
34-04	488	3.0	0.8	oleth-20	Sident 9
34-05	488	3.0	0.8	oleth-20	Sipernat 22
34-06	488	3.0	0.8	oleth-20	Sipernat 22S
34-07	488	3.0	1.5	steareth-20	Sident 9
34-08	488	3.0	1.5	steareth-20	Sipernat 22
34-09	488	3.0	1.5	steareth-20	Sipernat 22S
34-10	488	3.0	1.5	oleth-20	Sident 9
34-11	488	3.0	1.5	oleth-20	Sipernat 22
34-12	488	3.0	1.5	oleth-20	Sipernat 22S
34-13	488		0.8	none	Sident 9
34-14	488		1.5	none	Sipernat 22
34-15	488		0.8	none	Sipernat 22S
34-16	488		1.5	none	Sident 9
34-17	488		0.8	none	Sipernat 22
34-18	488		1.5	none	Sipernat 22S

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 34b.

Table 34b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	3	37
	200	10	57
	300	43	87
	400	57	88
Formulation J	100	33	80
	200	72	98
	300	96	99
	400	97	99
34-01	100	47	89
	200	78	97
	300	87	99
	400	98	99
34-02	100	37	83
	200	70	99
	300	90	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
	400	95	100
34-03	100	40	89
	200	70	99
	300	90	100
	400	95	100
34-04	100	37	94
	200	58	98
	300	87	99
	400	95	100
34-05	100	30	60
	200	73	95
	300	85	99
	400	97	99
34-06	100	33	67
	200	70	97
	300	78	99
	400	92	100
34-07	100	32	81
	200	60	99
	300	83	98
	400	88	100
34-08	100	40	63
	200	65	93
	300	90	99
	400	90	100
34-09	100	43	70
	200	55	98
	300	88	99
	400	94	100
34-10	100	33	91
	200	70	99
	300	83	99
	400	94	99
34-11	100	20	63
	200	70	97
	300	92	100
	400	94	100
34-12	100	48	67
	200	70	93
	300	88	98
	400	94	100
34-13	100	20	50
	200	60	83
	300	83	97
	400	94	99
34-14	100	43	43
	200	67	88
	300	83	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
	400	91	99
34-15	100	30	50
	200	67	73
	300	77	96
	400	97	96
34-16	100	43	43
	200	75	79
	300	87	94
	400	87	91
34-17	100	40	27
	200	68	53
	300	87	92
	400	93	98
34-18	100	47	10
	200	75	37
	300	83	63
	400	92	88

Many of the high-load (488 g a.e./l) glyphosate formulations of this Example exhibited herbicidal effectiveness equal to or greater than that obtained with commercial standard Formulation J, in spite of containing only 3% alkylether surfactant.

EXAMPLE 35

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 35a. Concentrate compositions 35-01 to 35-12 and 35-14 to 35-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 35-13 is an aqueous solution concentrate and was prepared by process (viii).

Table 35a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
35-01	163	0.5	5.0	butyl stearate	steareth-30
35-02	163	0.5	5.0	methyl stearate	steareth-30
35-03	163	0.5	5.0	butyl stearate	Neodol 45-13
35-04	163	0.5	5.0	methyl stearate	Neodol 45-13
35-05	163	0.5	5.0	butyl stearate	ceteareth-15
35-06	163	0.5	5.0	methyl stearate	ceteareth-15
35-07	163	0.5	5.0	butyl stearate	laureth-23
35-08	163	0.5	5.0	butyl stearate	oleth-20
35-09	163	0.5	5.0	butyl stearate	steareth-20
35-10	163	0.5	5.0	butyl stearate	ceteareth-27
35-11	163	0.3	5.0	butyl stearate	ceteareth-27
35-12	163	0.3	2.5	butyl stearate	ceteareth-27
35-13	163		5.0	none	ceteareth-27
35-14	163	0.5	5.0	methyl stearate	ceteareth-27
35-15	163	0.5	5.0	methyl stearate	steareth-20

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
35-16	163	0.5	5.0	methyl stearate	oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 35b.

Table 35b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	45	57
	200	35	53
	300	50	57
	400	38	33
Formulation C	100	70	98
	200	90	99
	300	97	100
	400	100	100
Formulation J	100	72	88
	200	93	99
	300	97	99
	400	98	99
35-01	100	83	97
	200	97	100
	300	99	100
	400	100	100
35-02	100	80	99
	200	96	100
	300	99	100
	400	99	100
35-03	100	73	98
	200	92	100
	300	98	99
	400	99	100
35-04	100	73	98
	200	87	99
	300	97	99
	400	99	100
35-05	100	80	98
	200	87	100
	300	98	100
	400	100	100
35-06	100	78	97
	200	95	98
	300	98	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
	400	99	100
35-07	100	78	98
	200	88	100
	300	96	100
	400	98	100
35-08	100	75	98
	200	93	99
	300	97	99
	400	100	99
35-09	100	83	93
	200	95	100
	300	98	100
	400	100	100
35-10	100	80	97
	200	95	98
	300	98	99
	400	100	100
35-11	100	80	97
	200	93	99
	300	98	100
	400	100	99
35-12	100	77	93
	200	88	100
	300	99	100
	400	99	100
35-13	100	80	73
	200	95	95
	300	99	100
	400	100	100
35-14	100	77	94
	200	92	99
	300	98	100
	400	100	99
35-15	100	78	92
	200	94	99
	300	98	100
	400	99	100
35-16	100	77	93
	200	90	98
	300	98	99
	400	99	100

Extremely high herbicidal effectiveness was provided by ceteareth-27 (composition 35-13); this was further enhanced by addition of a small amount of butyl stearate (35-10, 35-11) or methyl stearate (35-14). Compositions performing better than commercial standard Formulations C and J, at least on

ABUTH, included those containing steareth-30, steareth-20 or ceteareth-27; in this test oleth-20 was not quite as effective as these saturated alkylethers.

EXAMPLE 36

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 36a. All are oil-in-water emulsions and were prepared by process (vii). Lecithin (45% phospholipid, Avanti) was first dispersed in water using sonication.

Table 36a

Concentrate composition	Glyphosate g a.e./l	% w/w				
		Lecithin	Butyl stearate	Ethomeen T/25	Ceteareth-20	Ceteareth-27
36-01	220	0.75	0.75	1.5		
36-02	220	0.75	0.75	1.5		
36-03	220	0.75	0.75	3.0		
36-04	220	0.75	7.50	1.5		
36-05	220	0.75	7.50	3.0		
36-06	220	3.75	3.75	3.0		
36-07	220	1.50	1.50	3.0		
36-08	220	1.50	1.50	1.5		
36-09	220	3.75	3.75	1.5	1.5	
36-10	220	1.50	1.50	1.5	1.5	
36-11	220	3.75	7.50	1.5	1.5	
36-12	220	3.75	1.50	1.5	1.5	
36-13	220	0.75	3.75	1.5		1.5
36-14	220	0.75	7.50	1.5		1.5
36-15	220	0.75	3.75	3.0		3.0
36-16	220	0.75	7.50	3.0		3.0
36-17	220		7.50	3.0		
36-18	220	0.75	7.50			3.0

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 23 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 36b.

Table 36b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	12	62
	200	5	55
	300	23	63
	400	43	78

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	27	82
	200	62	98
	300	88	95
	400	96	99
36-01	100	13	79
	200	68	95
	300	82	99
	400	95	91
36-02	100	27	82
	200	60	97
	300	81	95
	400	87	99
36-03	100	37	77
	200	62	96
	300	78	98
	400	89	90
36-04	100	37	84
	200	57	95
	300	84	99
	400	89	100
36-05	100	33	77
	200	65	100
	300	78	97
	400	88	97
36-06	100	43	78
	200	62	95
	300	87	97
	400	95	96
36-07	100	48	78
	200	80	91
	300	90	99
	400	76	93
36-08	100	48	83
	200	67	89
	300	86	96
	400	93	97
36-09	100	62	84
	200	82	98
	300	85	99
	400	91	97
36-10	100	63	80
	200	75	96
	300	85	99
	400	99	99
36-11	100	42	75
	200	78	98
	300	92	99
	400	93	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
36-12	100	52	80
	200	73	93
	300	86	99
	400	97	97
36-13	100	55	83
	200	75	97
	300	97	99
	400	92	99
36-14	100	52	87
	200	73	95
	300	91	97
	400	87	98
36-15	100	57	83
	200	92	96
	300	98	100
	400	100	98
36-16	100	79	88
	200	87	97
	300	99	99
	400	97	94
36-17	100	58	83
	200	47	94
	300	88	98
	400	91	93
36-18	100	58	87
	200	75	91
	300	83	99
	400	91	98

Outstanding herbicidal effectiveness was provided by composition 93-18, containing lecithin, ceteareth-27 and butyl stearate. Addition of 3% Ethomeen T/25 (36-16) further enhanced effectiveness. Slightly reduced effectiveness at the lowest glyphosate rate was observed on ABUTH when the butyl stearate concentration was cut in half (36-15).

EXAMPLE 37

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 37a. Concentrate compositions 37-01 to 37-04, 37-06, 37-08, 37-10 and 37-18 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 37-05, 37-07 and 37-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 37-11 to 37-17 contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 37a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant
		Butyl stearate	Surfactant	Aerosil 380	
37-01	163	0.5	5.0		steareth-20
37-02	163	0.5	5.0		ceteareth-27
37-03	163	0.5	5.0		oleth-20
37-04	163	0.5	5.0		ceteth-20
37-05	163		5.0		ceteth-20
37-06	163	0.5	5.0		Neodol 45-13
37-07	163		5.0		Neodol 45-13
37-08	163	0.5	5.0		ceteareth-15
37-09	163		5.0		ceteareth-15
37-10	163	0.5	5.0		steareth-30
37-11	360	1.0	10.0	1.25	ceteth-20
37-12	360	1.0	10.0	1.25	Neodol 45-13
37-13	360	1.0	10.0	1.25	ceteareth-15
37-14	360	1.0	10.0	1.25	steareth-30
37-15	360	1.0	10.0	1.25	steareth-20
37-16	360	1.0	10.0	1.25	oleth-20
37-17	360	1.0	10.0	1.25	ceteareth-27
37-18	163	0.5	5.0		laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 37b.

Table 37b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	30
	200	2	60
	300	17	75
	400	50	73
Formulation J	100	20	63
	200	42	98
	300	75	100
	400	83	98
37-01	100	27	57
	200	67	98
	300	80	99
	400	87	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
37-02	100	27	63
	200	53	87
	300	77	99
	400	87	99
37-03	100	12	50
	200	53	99
	300	65	100
	400	83	99
37-04	100	20	63
	200	50	98
	300	73	98
	400	87	98
37-05	100	18	70
	200	57	93
	300	80	99
	400	83	99
37-06	100	17	63
	200	35	95
	300	60	100
	400	75	100
37-07	100	3	43
	200	43	95
	300	62	100
	400	68	96
37-08	100	20	43
	200	43	88
	300	75	99
	400	80	97
37-09	100	37	57
	200	55	93
	300	83	100
	400	83	99
37-10	100	37	50
	200	60	96
	300	83	99
	400	88	99
37-11	100	8	37
	200	37	93
	300	68	99
	400	70	97
37-12	100	13	43
	200	40	91
	300	67	100
	400	77	96
37-13	100	25	40
	200	40	80
	300	62	97
	400	78	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
37-14	100	23	33
	200	37	86
	300	75	99
	400	78	94
37-15	100	23	30
	200	43	78
	300	53	93
	400	78	98
37-16	100	23	37
	200	37	95
	300	63	97
	400	78	95
37-17	100	18	50
	200	45	88
	300	75	69
	400	73	93
37-18	100	missing	missing
	200	missing	missing
	300	missing	missing
	400	missing	missing

Compositions exhibiting herbicidal effectiveness greater than that provided by commercial standard Formulation J included 37-01 (steareth-20 plus butyl stearate), 37-09 (ceteareth-15) and 37-10 (steareth-20 plus butyl stearate).

EXAMPLE 38

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 38a. All are oil-in-water emulsions and were prepared by process (vii).

Table 38a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
38-01	163	1.00	10.0	laureth-23
38-02	163	0.50	5.0	laureth-23
38-03	163	0.25	2.5	laureth-23
38-04	163	1.00	10.0	Neodol 1-9
38-05	163	0.50	5.0	Neodol 1-9
38-06	163	0.25	2.5	Neodol 1-9
38-07	163	1.00	10.0	steareth-10
38-08	163	0.50	5.0	steareth-10
38-09	163	0.25	2.5	steareth-10
38-10	163	0.50	5.0	steareth-20
38-11	163	0.25	2.5	steareth-20
38-12	163	0.25	1.0	steareth-20
38-13	163	0.50	5.0	oleth-20
38-14	163	0.25	2.5	oleth-20

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
38-15	163	0.25	1.0	oleth-20
38-16	163	0.50	5.0	ceteareth-27
38-17	163	0.25	2.5	ceteareth-27
38-18	163	0.25	1.0	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 38b.

Table 38b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	42
	200	0	43
	300	23	50
	400	0	28
Formulation J	100	0	73
	200	57	85
	300	68	93
	400	87	94
38-01	100	18	75
	200	58	92
	300	85	90
	400	94	95
38-02	100	3	77
	200	47	90
	300	65	89
	400	87	95
38-03	100	13	80
	200	53	88
	300	72	98
	400	82	99
38-04	100	0	0
	200	53	88
	300	67	95
	400	83	95
38-05	100	2	60
	200	50	83
	300	70	93
	400	85	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
38-06	100	0	52
	200	55	83
	300	62	96
	400	77	98
38-07	100	8	70
	200	68	95
	300	91	99
	400	95	100
38-08	100	10	65
	200	67	99
	300	78	99
	400	93	100
38-09	100	5	80
	200	52	98
	300	75	100
	400	86	98
38-10	100	0	65
	200	62	84
	300	58	94
	400	75	100
38-11	100	5	83
	200	50	99
	300	63	97
	400	87	99
38-12	100	10	76
	200	60	96
	300	72	100
	400	100	100
38-13	100	20	85
	200	67	100
	300	91	100
	400	96	98
38-14	100	23	68
	200	62	89
	300	80	100
	400	99	99
38-15	100	5	57
	200	55	93
	300	89	95
	400	90	98
38-16	100	30	68
	200	68	94
	300	83	98
	400	100	100
38-17	100	43	68
	200	62	99
	300	78	100
	400	100	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
38-18	100	25	52
	200	53	84
	300	85	94
	400	98	95

Compositions having a 1:3 or lower weight/weight ratio of surfactant to glyphosate a.e., yet outperforming commercial standard Formulation J at least on ABUTH in this test, included those containing just 1% alkylether surfactant (ratio about 1:15) together with 0.25% butyl stearate, where the alkylether surfactant was steareth-20 (38-12), oleth-20 (38-15) or ceteareth-27 (38-18).

EXAMPLE 39

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 39a. All are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 39a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of surfactant	Type of Aerosil	Other component
		Surfactant	Aerosil	Other			
39-01	488	3.0	1.5		steareth-20	MOX-80/380 (1:2)	
39-02	488	4.5	1.5		steareth-20	380	
39-03	488	4.5	1.5		steareth-20	MOX-80/380 (1:2)	
39-04	488	4.5	1.5		steareth-20	MOX-80/MOX-170 (1:2)	
39-05	488	6.0	1.5	4.12	steareth-20	380	glycerin
39-06	488	3.0	1.5		steareth-20	380	
39-07	488	3.0	1.5	7.12	oleth-20	380	propylene glycol
39-08	488	3.0	1.5		oleth-20	MOX-80/380 (1:2)	
39-09	488	4.5	1.5		oleth-20	380	
39-10	488	4.5	1.5		oleth-20	MOX-80/380 (1:2)	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 39b.

Table 39b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	25
	200	35	27
	300	48	28
	400	47	48
Formulation J	100	50	75
	200	80	90
	300	97	96
	400	99	98
39-01	100	53	33
	200	83	52
	300	98	72
	400	98	79
39-02	100	43	27
	200	80	57
	300	87	73
	400	96	78
39-03	100	48	30
	200	81	70
	300	98	78
	400	63	57
39-04	100	45	32
	200	87	75
	300	97	73
	400	98	83
39-05	100	38	27
	200	37	23
	300	45	32
	400	35	18
39-06	100	42	40
	200	78	52
	300	91	72
	400	96	80
39-07	100	37	43
	200	48	32
	300	73	58
	400	55	28
39-08	100	43	37
	200	68	57
	300	84	62
	400	89	82
39-09	100	37	32
	200	83	67
	300	94	82
	400	63	48

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
39-10	100	32	40
	200	75	68
	300	90	88
	400	65	63

Several high-load (488 g a.e./l) glyphosate compositions exhibited herbicidal effectiveness on ABUTH equal to commercial standard Formulation J, but none was equal to Formulation J on ECHCF in this test.

EXAMPLE 40

Dry granular concentrate compositions were prepared containing glyphosate ammonium salt and excipient ingredients as shown in Table 40a. The preparation procedure was as follows. Ammonium glyphosate powder was added to a blender. Excipient ingredients were slowly added, together with sufficient water to wet the powder and form a stiff dough. The blender was operated for sufficient time to thoroughly mix all ingredients. The dough was then transferred to extrusion apparatus and was extruded to form granules, which were finally dried in a fluid bed dryer.

Table 40a

Conc. comp.	% w/w					Type of surfactant	Type of colloidal particulate
	Glyphosate a.e.	Lecithin	Butyl stearate	Surfactant	Colloidal particulate		
40-01	68.7			21.0		steareth-20	
40-02	66.0		2.2	22.0		steareth-20	
40-03	66.1			24.0		oleth-20	
40-04	66.0		2.2	22.0		oleth-20	
40-05	67.9	10.0	2.0	10.0		MON 0818	
40-06	59.2	10.0		20.0 + 2.0		FC-754 + MON 0818	
40-07	68.0			21.0	0.8	Flomo 1407	Aerosil 90
40-08	68.0			21.0	0.8	Flomo 1407	Aluminum oxide C
40-09	66.1			24.0		ceteth-20	
40-10	66.0		2.2	22.0		ceteth-20	
40-11	71.2			16.1	2.0	ceteth-20	Aerosil 380
40-12	71.1			16.3	1.0	ceteth-20	Aerosil blend (*)
40-13	71.2			16.1	2.0	steareth-20	Aerosil 380
40-14	71.2			16.1	1.0	steareth-20	Aerosil blend (*)
40-15	68.0			20.0	1.9	oleth-20	Aerosil-380
40-16	70.8			16.6	1.0	oleth-20	Aerosil blend (*)

(*) Aerosil MOX-80 + Aerosil MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations J and K were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 40b.

Table 40b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	52	80
	200	90	96
	300	96	100
	400	97	99
Formulation K	100	33	70
	200	67	93
	300	83	99
	400	93	100
40-01	100	47	60
	200	87	98
	300	97	98
	400	100	98
40-02	100	47	63
	200	80	94
	300	90	99
	400	98	100
40-03	100	62	62
	200	83	93
	300	97	96
	400	97	100
40-04	100	47	57
	200	78	94
	300	87	100
	400	98	100
40-05	100	25	53
	200	60	88
	300	80	97
	400	83	98
40-06	100	35	37
	200	65	62
	300	83	83
	400	90	95
40-07	100	63	55
	200	72	97
	300	83	100
	400	94	100
40-08	100	30	65
	200	72	94
	300	87	100
	400	92	99
40-09	100	37	63
	200	77	83
	300	88	99
	400	97	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
40-10	100	40	55
	200	83	93
	300	94	96
	400	98	99
40-11	100	42	55
	200	78	94
	300	88	92
	400	94	99
40-12	100	38	58
	200	78	97
	300	92	97
	400	95	100
40-13	100	25	50
	200	80	88
	300	96	95
	400	98	98
40-14	100	50	53
	200	88	92
	300	98	99
	400	99	99
40-15	100	33	57
	200	75	91
	300	94	97
	400	98	99
40-16	100	33	55
	200	77	90
	300	88	99
	400	96	100

Several dry granular compositions of this Example outperformed commercial standard composition K, at least on ABUTH. They included 40-01 to 40-04 and 40-10 to 40-16, all containing an alkylether surfactant (steareth-20, oleth-20 or ceteth-20).

EXAMPLE 41

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 41a. All are oil-in-water emulsions and were prepared by process (vii). Soybean lecithin (45% phospholipid, Avanti) was first dispersed in water either by ultrasonication or by use of a microfluidizer as indicated in the column of Table 41a headed "Process".

Table 41a

Conc. comp.	Glyphosate g a.e./l	% w/w						Process (*)
		Lecithin	Butyl stearate	Ethomeen T/25	MON 0818	Ceteareth-20	Ceteareth-27	
41-01	220	0.75	3.75	3.0			3.0	B
41-02	220	0.75	0.75	3.0			3.0	B

Conc. comp.	Glyphosate g a.e./l	% w/w						Process (*)
		Lecithin	Butyl stearate	Ethomeen T/25	MON 0818	Ceteareth-20	Ceteareth-27	
41-03	220	0.75	3.75	3.0		3.0		B
41-04	220	0.75	0.75	3.0		3.0		B
41-05	220	6.00	1.50	3.0		3.0		B
41-06	220	6.00	1.50	3.0			3.0	B
41-07	220	4.00	1.00	3.0		3.0		B
41-08	220	4.00	1.00	3.0			3.0	B
41-09	220	0.75	3.75	3.0			3.0	A
41-10	220	0.75	0.75	3.0			3.0	A
41-11	220	0.75	3.75	6.0				B
41-12	220	0.75	3.75			6.0		B
41-13	345	6.00	1.50	4.5	4.5			B
41-14	345	6.00	1.50	6.0			3.0	B
41-15	345	6.00	1.50	6.0	6.0			B
41-16	345	0.50	7.50	12.0				B
41-17	345	6.00	1.50	4.5	4.5		3.0	B

(*) Process:

A Ultrasonicated
B Microfluidized, 3 cycles

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 41b.

Table 41b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	45	82
	250	55	71
	350	80	72
	450	88	77
Formulation J	150	55	83
	250	89	88
	350	97	93
	450	99	93
	550	99	87
41-01	150	92	83
	250	96	96
	350	99	96
	450	100	86

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
41-02	150	85	93
	250	97	78
	350	97	90
	450	99	90
41-03	150	87	85
	250	98	92
	350	99	95
	450	100	95
41-04	150	87	89
	250	97	92
	350	99	94
	450	99	91
41-05	150	87	77
	250	98	89
	350	99	93
	450	99	84
41-06	150	12	18
	250	96	73
	350	99	85
	450	99	84
41-07	150	82	89
	250	88	96
	350	96	98
	450	97	97
41-08	150	88	94
	250	95	90
	350	99	98
	450	99	98
41-09	150	94	94
	250	95	100
	350	97	99
	450	99	98
41-10	150	94	94
	250	98	99
	350	99	97
	450	99	96
41-11	150	83	81
	250	94	88
	350	98	93
	450	99	99
41-12	150	68	79
	250	95	96
	350	98	100
	450	99	98
41-13	150	86	98
	250	95	98
	350	99	100
	450	100	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
41-14	150	85	98
	250	98	98
	350	99	98
	450	100	98
41-15	150	86	95
	250	97	97
	350	99	95
	450	100	96
41-16	150	93	94
	250	98	98
	350	99	98
	450	100	97
41-17	150	95	96
	250	98	100
	350	100	100
	450	100	98

Many compositions containing lecithin and butyl stearate, together with ceteareth-20 or ceteareth-27, outperformed commercial standard Formulation J in this test.

EXAMPLE 42

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 42a. Concentrate compositions 42-04 and 42-05 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 42-06 to 42-13 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 42-01 to 42-03 contain colloidal particulate but no surfactant.

The compositions of this example containing colloidal particulate all showed acceptable storage stability. Of those containing steareth-20 but no colloidal particulate, composition 42-04 was acceptable storage-stable but composition 42-05 was not.

Table 42a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Steareth-20	Oleth-20	Aerosil	
42-01	484			1.5	MOX-80
42-02	484			1.5	380
42-03	484			1.5	MOX-80/MOX-170 (1:1)
42-04	484	1.5			none
42-05	484	3.0			none
42-06	484	3.0		1.5	MOX-170
42-07	484	3.0		1.5	380
42-08	484	3.0		1.5	MOX-80/380 (1:1)
42-09	484	3.0		1.5	MOX-80/MOX-170 (1:1)
42-10	484		3.0	1.5	MOX-80
42-11	484		3.0	1.5	MOX-170
42-12	484		3.0	1.5	380

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Steareth-20	Oleth-20	Aerosil	
42-13	484		3.0	1.5	MOX-80/380 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 42b.

Table 42b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	3	38
	200	28	63
	300	37	75
	400	55	78
Formulation J	100	23	73
	200	43	92
	300	67	96
	400	92	97
42-01	100	23	60
	200	40	77
	300	65	91
	400	75	92
42-02	100	18	50
	200	25	53
	300	33	75
	400	67	82
42-03	100	27	57
	200	35	72
	300	50	86
	400	70	93
42-04	100	42	67
	200	48	78
	300	78	82
	400	80	85
42-05	100	28	43
	200	45	77
	300	70	92
	400	80	95
42-06	100	42	57
	200	70	75
	300	89	87
	400	94	94

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
42-07	100	43	68
	200	62	90
	300	88	92
	400	97	92
42-08	100	53	57
	200	72	87
	300	88	94
	400	92	97
42-09	100	27	60
	200	62	75
	300	75	92
	400	83	90
42-10	100	47	43
	200	73	73
	300	82	88
	400	97	93
42-11	100	48	57
	200	63	75
	300	80	91
	400	89	98
42-12	100	30	40
	200	42	63
	300	68	75
	400	73	83
42-13	100	37	40
	200	57	75
	300	73	80
	400	78	94

Remarkably strong herbicidal effectiveness was provided by composition 42-05, in spite of its very low surfactant (steareth-20) to glyphosate a.e. ratio of about 1:13. Activity, at least on ABUTH, was further improved to a significant degree by inclusion in the composition of colloidal particulates such as Aerosil MOX-170 (42-06), Aerosil 380 (42-07), a blend of Aerosil MOX-80 and Aerosil 380 (42-08), and a blend of Aerosil MOX-80 and Aerosil MOX-170 (42-09).

EXAMPLE 43

Aqueous and dry granular concentrate compositions were prepared as shown in Table 43a. Dry granular concentrate compositions 43-01 to 43-11 contain glyphosate ammonium salt, and were prepared by the procedure described in Example 40.

Aqueous concentrate compositions 43-12 to 43-16 contain glyphosate IPA salt and soybean lecithin (45% phospholipid, Avanti) and were prepared by process (v).

Table 43a

Conc. comp.	Glyphos-ate g a.e./l	% w/w					Type of surfactant	Type of colloidal particulate
		Glyphos-ate a.e.	Lecithin	Butyl stearate	Surfactant	Colloidal particulate		
43-01		68.7			21.0		steareth-20	
43-02		66.1			24.0		oleth-20	
43-03		67.9	10.0	2.0	10.0		MON 0818	
43-04		59.2	10.0		20.0 + 2.0		FC-754 + MON 0818	
43-05		66.1			24.0		ceteth-20	
43-06		71.2			16.1	2.0	steareth-20	Aerosil 380
43-07		71.2			16.1	2.0	steareth-20	Aerosil blend
43-08		68.0			20.0	1.9	oleth-20	Aerosil 380
43-09		63.5			25.0	2.0	steareth-20	Aerosil blend
43-10		67.9			20.0	2.0	steareth-20	Aerosil blend
43-11		72.2			15.0	2.0	steareth-20	Aerosil blend
43-12	370		4.7		4.7		steareth-20	
43-13	350		4.9		4.9		ceteareth-27	
43-14	348		5.0		5.0		ceteareth-15	
43-15	348		5.0		5.0		oleth-20	
43-16	351		4.4		5.0		steareth-30	

Aerosil blend: Aerosil MOX-80 + Aerosil MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations J and K were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 43b.

Table 43b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	0	20
	200	28	57
	300	58	96
	400	73	99
Formulation K	100	22	13
	200	42	83
	300	48	91
	400	58	95
43-01	100	28	30
	200	48	80
	300	80	97
	400	85	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
43-02	100	43	52
	200	68	80
	300	72	88
	400	86	94
43-03	100	23	37
	200	50	83
	300	75	88
	400	85	96
43-04	100	50	45
	200	73	80
	300	85	92
	400	95	94
43-05	100	18	45
	200	65	83
	300	87	95
	400	94	86
43-06	100	47	50
	200	62	68
	300	82	94
	400	91	87
43-07	100	50	47
	200	60	78
	300	87	87
	400	93	93
43-08	100	30	55
	200	55	77
	300	82	85
	400	88	97
43-09	100	45	50
	200	57	78
	300	83	83
	400	84	89
43-10	100	42	50
	200	57	80
	300	73	91
	400	91	90
43-11	100	28	48
	200	50	75
	300	70	87
	400	82	89
43-12	100	20	40
	200	63	80
	300	67	96
	400	80	88
43-13	100	27	35
	200	50	85
	300	77	90
	400	84	86

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
43-14	100	27	25
	200	40	70
	300	68	94
	400	89	91
43-15	100	17	20
	200	47	82
	300	58	89
	400	91	95
43-16	100	22	20
	200	41	80
	300	84	89
	400	99	98

All compositions of the invention in this study exhibited greater herbicidal effectiveness on both ABUTH and ECHCF, in some cases by a very substantial margin, than commercial standard Formulation K.

EXAMPLE 44

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 44a. Concentrate compositions 44-01 to 44-07, 44-17 and 44-18 were prepared by process (v). Concentrate compositions 44-08 to 44-15 were prepared by process (x). Concentrate composition 44-16 was prepared by process (viii).

Table 44a

Conc. comp.	Glyphosate g a.e./l	% w/w						
		Lecithin	Fluorad FC-754	Butyl stearate	Ethomeen T/25	Ceteareth-20	Arcosolve DPM	Ceteareth-27
44-01	348	3.0	3.00		0.75			
44-02	348	3.8	3.75		5.00			
44-03	348	3.8	3.75		7.50			
44-04	348	2.0	5.00		0.75			
44-05	348	5.0	5.00		0.75			
44-06	348	2.0	2.00					
44-07	348	1.0	1.00					
44-08	220	1.5		1.5	3.00	3.0		
44-09	220	1.5		1.5	3.00			3.0
44-10	220	1.5		1.5	6.00	3.0		
44-11	220	1.5		1.5	6.00			3.0
44-12	220	3.0		1.5	3.00	3.0		
44-13	220	3.0		1.5	3.00			3.0
44-14	348	1.5		1.5	6.00	3.0		
44-15	348	3.0		1.5	3.00	3.0		
44-16	348		3.00					
44-17	348	3.0					3.0	
44-18	348	5.0			13.00		5.0	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 44b.

Table 44b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	28	32
	200	41	37
	300	73	64
	400	22	30
Formulation J	100	38	32
	200	82	73
	300	89	91
	400	97	89
44-01	100	73	28
	200	90	66
	300	97	92
	400	100	96
44-02	100	77	32
	200	87	67
	300	84	78
	400	98	84
44-03	100	79	33
	200	82	66
	300	99	81
	400	97	88
44-04	100	69	35
	200	95	59
	300	96	84
	400	92	91
44-05	100	82	32
	200	92	55
	300	96	71
	400	94	87
44-06	100	83	33
	200	100	52
	300	100	68
	400	99	75
44-07	100	77	35
	200	90	58
	300	95	71
	400	94	90

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
44-08	100	51	40
	200	89	75
	300	96	92
	400	95	98
44-09	100	76	57
	200	98	81
	300	97	86
	400	96	98
44-10	100	69	60
	200	98	63
	300	95	82
	400	99	90
44-11	100	61	60
	200	94	84
	300	97	89
	400	99	97
44-12	100	64	53
	200	95	82
	300	96	90
	400	95	98
44-13	100	61	58
	200	94	78
	300	88	87
	400	100	94
44-14	100	56	61
	200	88	77
	300	91	82
	400	97	89
44-15	100	42	52
	200	82	80
	300	86	90
	400	97	92
44-16	100	64	49
	200	86	75
	300	97	88
	400	100	82
44-17	100	57	32
	200	88	66
	300	95	73
	400	100	88
44-18	100	52	35
	200	70	77
	300	82	79
	400	97	73

Compositions 44-08 to 44-15, containing lecithin, butyl stearate, Ethomeen T/25 and a C_{16-18} alkylether surfactant (ceteareth-20 or ceteareth-27) exhibited a very high degree of herbicidal

effectiveness. Not only was performance, at least of 44-08 to 44-13, on ABUTH substantially better than that of Formulation J, these compositions performed considerably better than Formulation J on ECHCF as well.

EXAMPLE 45

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 45a. All contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 45a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of oil	Type of surfactant
		Oil	Surfactant	Aerosil 380		
45-01	360	1.0	10.0	1.25	butyl stearate	oleth-20
45-02	360	1.0	10.0	1.25	stearylamine	oleth-20
45-03	360	1.0	10.0	1.25	stearyl alcohol	oleth-20
45-04	360	1.0	10.0	1.25	docosane	oleth-20
45-05	360		10.0	1.25	none	oleth-20
45-06	360	1.0	10.0	1.25	butyl stearate	steareth-30
45-07	360	1.0	10.0	1.25	stearylamine	steareth-30
45-08	360	1.0	10.0	1.25	stearyl alcohol	steareth-30
45-09	360	1.0	10.0	1.25	docosane	steareth-30
45-10	360		10.0	1.25	none	steareth-30
45-11	360		5.0 + 5.0	1.25	none	oleth-20 + steareth-20
45-12	360		5.0 + 5.0	1.25	none	oleth-20 + steareth-30
45-13	360		5.0 + 5.0	1.25	none	oleth-20 + ceteareth-27
45-14	360		5.0 + 5.0	1.25	none	oleth-20 + ceteareth-15
45-15	360		5.0 + 5.0	1.25	none	steareth-30 + steareth-20
45-16	360		5.0 + 5.0	1.25	none	steareth-30 + ceteareth-27
45-17	360		5.0 + 5.0	1.25	none	steareth-30 + ceteareth-15
45-18	360		10.0	1.25	none	laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 45b.

Table 45b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	60
	200	15	73
	300	33	88
	400	57	91
Formulation J	100	5	70
	200	37	92
	300	80	99
	400	77	96
45-01	100	13	88
	200	32	85
	300	48	98
	400	90	93
45-02	100	10	70
	200	45	98
	300	72	99
	400	80	98
45-03	100	3	77
	200	25	94
	300	47	98
	400	75	99
45-04	100	7	67
	200	23	94
	300	40	99
	400	7	47
45-05	100	7	76
	200	25	88
	300	45	96
	400	75	97
45-06	100	12	96
	200	30	97
	300	45	98
	400	15	60
45-07	100	8	83
	200	12	97
	300	35	94
	400	50	98
45-08	100	15	72
	200	30	88
	300	40	99
	400	0	33
45-09	100	5	73
	200	15	94
	300	47	99
	400	5	53

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
45-10	100	7	79
	200	15	95
	300	45	98
	400	62	99
45-11	100	5	84
	200	13	98
	300	30	98
	400	55	100
45-12	100	3	95
	200	17	99
	300	28	99
	400	67	100
45-13	100	5	90
	200	17	99
	300	30	100
	400	60	98
45-14	100	3	98
	200	25	97
	300	38	100
	400	57	100
45-15	100	5	97
	200	25	97
	300	40	100
	400	40	99
45-16	100	10	97
	200	15	98
	300	52	100
	400	0	47
45-17	100	7	97
	200	25	94
	300	40	98
	400	33	97
45-18	100	7	96
	200	25	99
	300	55	100
	400	73	100

Percent inhibition data for the 400 g a.e./ha glyphosate rate in this test are unreliable and should be ignored. Neither oleth-20 (composition 45-05) nor steareth-20 (45-10) provided herbicidal effectiveness equal to Formulation J in this study, and no great or consistent further enhancement was obtained by adding butyl stearate.

EXAMPLE 46

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 46a. Concentrate compositions 46-01 to 46-03 are oil-in-water emulsions

and were prepared by process (vii). Compositions 46-04 to 46-18 all contain colloidal particulates and were prepared by process (ix). Different mixing methods were employed in the final stage of preparation of these compositions, as indicated in the column of Table 46a headed "Process".

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 46a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant	Process (*)
		Butyl stearate	Surfactant	Aerosil 380		
46-01	163	0.5	5.0		oleth-20	
46-02	163	0.5	5.0		steareth-20	
46-03	163	0.5	5.0		ceteareth-27	
46-04	360	1.0	10.0	1.25	ceteareth-15	A
46-05	360	1.0	10.0	1.25	ceteth-20	A
46-06	360	1.0	10.0	1.25	steareth-20	A
46-07	360	1.0	10.0	1.25	oleth-20	A
46-08	360	1.0	10.0	1.25	ceteareth-27	A
46-09	360	1.0	10.0	1.25	steareth-30	A
46-10	360		10.0	1.25	steareth-30	A
46-11	360	1.0	10.0	1.25	oleth-20	A
46-12	360	1.0	10.0	1.25	oleth-20	B
46-13	360	1.0	10.0	1.25	oleth-20	C
46-14	360	1.0	10.0	1.25	oleth-20	D
46-15	360	1.0	10.0	1.25	oleth-20	E
46-16	360	1.0	10.0	1.25	oleth-20	F
46-17	360	1.0	10.0	1.25	oleth-20	G
46-18	360	1.0	10.0	1.25	oleth-20	A

(*) Process:

A	Silverson mixer, medium screen, 3 minutes at 7000 rpm
B	Silverson mixer, coarse screen, 3 minutes at 7000 rpm
C	Fann mixer, 50% output, 5 minutes
D	Turrax mixer, 3 minutes at 8000 rpm
E	Overhead stirrer, low speed
F	Overhead stirrer, high speed
G	Hand shaking, 3 minutes

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 46b.

Table 46b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	20	40
	200	45	50
	300	65	72
	400	78	85
Formulation J	100	43	53
	200	80	80
	300	96	82
	400	99	94
46-01	100	45	57
	200	80	72
	300	89	78
	400	98	83
46-02	100	53	57
	200	80	78
	300	89	77
	400	93	83
46-03	100	45	60
	200	83	75
	300	97	73
	400	97	85
46-04	100	45	45
	200	80	80
	300	83	83
	400	95	95
46-05	100	42	42
	200	77	77
	300	93	93
	400	98	98
46-06	100	30	30
	200	42	42
	300	27	30
	400	3	20
46-07	100	40	40
	200	77	75
	300	90	93
	400	97	86
46-08	100	43	50
	200	80	80
	300	92	93
	400	96	98
46-09	100	0	2
	200	82	75
	300	83	96
	400	90	88

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
46-10	100	57	60
	200	80	70
	300	88	88
	400	95	93
46-11	100	35	47
	200	72	75
	300	80	75
	400	85	77
46-12	100	47	47
	200	72	77
	300	80	90
	400	86	78
46-13	100	55	50
	200	75	83
	300	78	92
	400	91	92
46-14	100	52	50
	200	75	78
	300	83	88
	400	99	92
46-15	100	47	47
	200	70	73
	300	87	87
	400	75	63
46-16	100	43	40
	200	78	75
	300	88	88
	400	87	91
46-17	100	43	43
	200	67	88
	300	80	75
	400	92	83
46-18	100	27	40
	200	63	57
	300	82	73
	400	87	70

Results obtained with composition 46-06 are out of line with other data in this Example and an error in formulation or application is suspected. Some differences in herbicidal effectiveness were evident when a composition containing 360 g a.e./l glyphosate, 1% butyl stearate, 10% oleth-20 and 1.25% Aerosil 380 was processed in different ways (46-11 to 46-17). However, as compositions 46-07 and 46-11 were identically processed yet differed in effectiveness, no firm conclusions can be drawn from this test.

EXAMPLE 47

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 47a. Concentrate compositions 47-01 to 47-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 47-10 to 47-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions of this example containing 3% or 6% surfactant were not acceptably storage-stable except in the presence of colloidal particulate as shown.

Table 47a

Composition no.	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Oleth-20	Velvetex AB-45	Aerosil	
47-01	488	1.0				none
47-02	488	3.0				none
47-03	488	6.0				none
47-04	488		1.0			none
47-05	488		3.0			none
47-06	488		6.0			none
47-07	488			1.0		none
47-08	488			3.0		none
47-09	488			4.6		none
47-10	488	1.0			1.5	MOX-80/MOX-170 (1:1)
47-11	488	3.0			1.5	MOX-80/MOX-170 (1:1)
47-12	488	6.0			1.5	MOX-80/MOX-170 (1:1)
47-13	488		1.0		1.5	MOX-80/MOX-170 (1:1)
47-14	488		3.0		1.5	MOX-80/MOX-170 (1:1)
47-15	488		6.0		1.5	MOX-80/MOX-170 (1:1)
47-16	488			1.0	1.5	MOX-80/MOX-170 (1:1)
47-17	488			3.0	1.5	MOX-80/MOX-170 (1:1)
47-18	488			4.6	1.5	MOX-80/MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 47b.

Table 47b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	10	40
	200	38	67
	300	70	80
	400	86	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	43	58
	200	65	82
	300	91	94
	400	100	95
47-01	100	23	60
	200	40	65
	300	73	87
	400	80	92
47-02	100	38	67
	200	77	82
	300	95	83
	400	99	93
47-03	100	33	67
	200	78	73
	300	90	94
	400	100	96
47-04	100	23	63
	200	48	81
	300	68	87
	400	72	88
47-05	100	30	63
	200	63	80
	300	78	89
	400	95	93
47-06	100	25	85
	200	68	93
	300	77	93
	400	99	95
47-07	100	13	60
	200	42	80
	300	57	95
	400	92	96
47-08	100	20	73
	200	43	92
	300	83	93
	400	72	96
47-09	100	30	73
	200	50	94
	300	65	96
	400	75	98
47-10	100	10	65
	200	53	88
	300	72	94
	400	83	95
47-11	100	15	50
	200	57	77
	300	82	95
	400	92	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
47-12	100	30	70
	200	68	98
	300	78	97
	400	96	98
47-13	100	15	77
	200	43	93
	300	68	95
	400	77	99
47-14	100	10	73
	200	40	93
	300	68	98
	400	78	98
47-15	100	missing	missing
	200	missing	missing
	300	missing	missing
	400	missing	missing
47-16	100	0	60
	200	30	93
	300	40	99
	400	50	99
47-17	100	2	83
	200	43	99
	300	67	100
	400	67	100
47-18	100	5	95
	200	37	100
	300	60	100
	400	78	100

In high-load (488 g a.e./l) glyphosate compositions, steareth-20 at 3% or 6% provided greater herbicidal effectiveness in this test than the same concentrations of oleth-20. Even at just 3%, steareth-20 (composition 47-02) gave effectiveness equal to commercial standard Formulation J. Addition of a blend of colloidal particulates to stabilize the composition (47-11) slightly reduced effectiveness in this study.

EXAMPLE 48

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 48a. Concentrate compositions 48-01 to 48-04 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 48-08 to 48-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 48-05 to 48-07 contain colloidal particulate but no surfactant.

All compositions of this example except 48-01 to 48-03 were acceptably storage-stable.

Table 48a

Concentrate composition	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Steareth-100	MON 0818	Aerosil	
48-01	488	3.0				
48-02	488	4.5				
48-03	488	6.0				
48-04	488			3.0		
48-05	488				1.5	380
48-06	488				1.5	MOX-80/MOX-170 (1:1)
48-07	488				3.0	MOX-80/380 (1:1)
48-08	488		1.5			
48-09	488	3.0		3.0	1.5	380
48-10	488	4.5		3.0	1.5	380
48-11	488	6.0		3.0	1.5	380
48-12	488	3.0		3.0	1.5	MOX-80/MOX-170 (1:1)
48-13	488	4.5		3.0	1.5	MOX-80/MOX-170 (1:1)
48-14	488	6.0		3.0	1.5	MOX-80/MOX-170 (1:1)
48-15	488	3.0		3.0	1.5	MOX-80/380 (1:1)
48-16	488	4.5		3.0	1.5	MOX-80/380 (1:1)
48-17	488	6.0		3.0	1.5	MOX-80/380 (1:1)
48-18	488		4.5	3.0	1.5	MOX-80/MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 48b.

Table 48b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	23
	200	18	50
	300	42	67
	400	63	80
Formulation J	100	20	47
	200	40	86
	300	83	98
	400	93	98
48-01	100	10	75
	200	62	83
	300	80	96
	400	93	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
48-02	100	40	60
	200	77	92
	300	87	97
	400	93	99
48-03	100	23	40
	200	38	63
	300	78	91
	400	97	91
48-04	100	20	38
	200	23	77
	300	43	94
	400	73	94
48-05	100	7	30
	200	25	37
	300	42	60
	400	67	63
48-06	100	7	30
	200	20	53
	300	52	67
	400	83	67
48-07	100	5	35
	200	20	63
	300	57	80
	400	43	85
48-08	100	22	83
	200	47	99
	300	86	98
	400	78	100
48-09	100	12	45
	200	25	77
	300	40	83
	400	37	95
48-10	100	13	53
	200	73	99
	300	85	98
	400	99	99
48-11	100	25	50
	200	60	88
	300	93	99
	400	99	99
48-12	100	25	45
	200	57	88
	300	85	97
	400	100	94
48-13	100	30	52
	200	68	87
	300	93	99
	400	100	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
48-14	100	40	45
	200	73	88
	300	81	98
	400	100	99
48-15	100	8	57
	200	33	96
	300	81	99
	400	95	99
48-16	100	10	62
	200	48	83
	300	99	98
	400	100	100
48-17	100	27	58
	200	65	92
	300	75	98
	400	93	99
48-18	100	5	40
	200	33	87
	300	55	98
	400	75	98

Among stabilized high-load (488 g a.e./l) glyphosate compositions providing herbicidal effectiveness superior to commercial standard Formulation J, at least on ABUTH, were 48-10 and 48-11 (respectively 4.5% and 6% steareth-20 + 3% MON 0818 + 1.5% Aerosil 380), 48-13 (4.5% steareth-20 + 3% MON 0818 + 1.5% Aerosil MOX-80/MOX-170 blend) and 48-16 (4.5% steareth-20 + 3% MON 0818 + 1.5% Aerosil MOX-80/380 blend). The relatively poor performance of composition 48-04 and the good performance of composition 48-02 shows that the excellent results obtained with the stabilized compositions listed above are primarily attributable to the steareth-20 component.

EXAMPLE 49

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 49a. Concentrate compositions 49-01 to 49-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 49-10 to 49-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions of this example containing 3% or 6% surfactant were not acceptably storage-stable except in the presence of colloidal particulate as shown.

Table 49a

Concentrate composition	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Oleth-20	Velvetex AB-45	Aerosil	
49-01	488	1.5				none
49-02	488	3.0				none
49-03	488	6.0				none
49-04	488		1.5			none
49-05	488		3.0			none
49-06	488		6.0			none
49-07	488			1.5		none
49-08	488			3.0		none
49-09	488			4.5		none
49-10	488	1.5			1.5	MOX-80/380 (1:1)
49-11	488	3.0			1.5	MOX-80/380 (1:1)
49-12	488	6.0			1.5	MOX-80/380 (1:1)
49-13	488		1.5		1.5	MOX-80/380 (1:1)
49-14	488		3.0		1.5	MOX-80/380 (1:1)
49-15	488		6.0		1.5	MOX-80/380 (1:1)
49-16	488			1.5	1.5	MOX-80/380 (1:1)
49-17	488			3.0	1.5	MOX-80/380 (1:1)
49-18	488			4.5	1.5	MOX-80/380 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 49b.

Table 49b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	10
	200	3	27
	300	13	30
	400	33	40
Formulation J	100	2	53
	200	30	97
	300	70	99
	400	80	99
49-01	100	5	67
	200	30	89
	300	58	98
	400	80	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
49-02	100	20	60
	200	45	90
	300	78	99
	400	80	100
49-03	100	20	57
	200	47	93
	300	78	96
	400	83	98
49-04	100	3	57
	200	30	83
	300	63	99
	400	82	98
49-05	100	5	53
	200	27	83
	300	47	98
	400	77	100
49-06	100	5	40
	200	23	70
	300	47	92
	400	77	99
49-07	100	3	53
	200	30	85
	300	60	94
	400	72	97
49-08	100	3	50
	200	22	88
	300	53	97
	400	80	100
49-09	100	0	40
	200	20	83
	300	40	99
	400	67	99
49-10	100	0	40
	200	27	60
	300	47	83
	400	78	94
49-11	100	5	47
	200	25	77
	300	57	96
	400	87	97
49-12	100	15	43
	200	52	88
	300	87	98
	400	87	98
49-13	100	0	40
	200	17	70
	300	35	83
	400	53	88

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
49-14	100	0	33
	200	18	67
	300	28	90
	400	62	98
49-15	100	2	33
	200	25	70
	300	53	85
	400	72	97
49-16	100	0	30
	200	17	50
	300	27	67
	400	72	87
49-17	100	0	0
	200	7	63
	300	32	88
	400	47	90
49-18	100	0	5
	200	12	60
	300	25	83
	400	45	97

Compositions containing steareth-20 generally performed better than counterparts containing oleth-20 in this study, both in the presence and in the absence of colloidal particulates.

EXAMPLE 50

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 50a. All contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 50a

Concentrate composition	% w/w				Type of oil	Type of surfactant
	Glyphosate a.e.	Oil	Surfactant	Aerosil 380		
50-01	31	1.0	10.0	1.25	Butyl stearate	steareth-20
50-02	31	1.0	10.0	1.25	Butyl stearate	oleth-20
50-03	31	1.0	10.0	1.25	Butyl stearate	steareth-30
50-04	31		10.0	1.25	none	steareth-30

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Treatments were applied at four different hours of the day. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application.

Formulation J was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 50b.

Table 50b

Concentrate composition	Hour when applied	Glyphosate rate g a.e./ha	% Inhibition	
			ABUTH	ECHCF
Formulation J	1000	100	5	33
		200	42	75
		300	67	83
		400	77	93
50-01	1000	100	7	33
		200	40	70
		300	50	82
		400	78	91
50-02	1000	100	18	33
		200	37	73
		300	48	91
		400	80	92
50-03	1000	100	30	33
		200	40	75
		300	82	85
		400	83	80
50-04	1000	100	30	30
		200	43	78
		300	78	92
		400	93	95
Formulation J	1200	100	5	38
		200	35	87
		300	53	96
		400	88	99
50-01	1200	100	10	30
		200	47	91
		300	70	89
		400	78	97
50-02	1200	100	5	37
		200	40	75
		300	48	87
		400	70	94
50-03	1200	100	20	37
		200	50	82
		300	78	98
		400	83	97
50-04	1200	100	33	33
		200	45	93
		300	75	98
		400	95	100
Formulation J	1400	100	15	40
		200	30	90
		300	55	100
		400	80	100

Concentrate composition	Hour when applied	Glyphosate rate g a.e./ha	% Inhibition	
			ABUTH	ECHCF
50-01	1400	100	17	40
		200	45	70
		300	75	97
		400	80	98
50-02	1400	100	17	47
		200	35	83
		300	67	97
		400	63	97
50-03	1400	100	30	40
		200	63	80
		300	77	97
		400	78	100
50-04	1400	100	23	40
		200	45	87
		300	73	100
		400	78	100
Formulation J	1600	100	10	37
		200	32	83
		300	52	97
		400	75	98
50-01	1600	100	27	43
		200	40	89
		300	77	99
		400	95	99
50-02	1600	100	20	53
		200	40	95
		300	53	98
		400	80	98
50-03	1600	100	27	60
		200	60	93
		300	78	97
		400	96	100
50-04	1600	100	15	37
		200	43	83
		300	67	97
		400	78	96

Composition 50-03 illustrates the consistency of high-level performance obtainable with, in this case, steareth-30 at an approximately 1:3 weight/weight ratio to glyphosate a.e., together with a small amount of butyl stearate and Aerosil 380. An average of percent inhibition of ABUTH across all four glyphosate rates shows the following comparison of 50-03 with Formulation J, applied at four different hours of the day:

Hour	Formulation J	Composition 50-03
1000	48	59
1200	45	58
1400	48	62

1600	42	65

EXAMPLE 51

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 51a. Concentrate compositions 51-01 to 51-07 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 51-08 to 51-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions 51-01 to 51-06 were not acceptably storage-stable. All other compositions showed acceptable storage stability.

Table 51a

Concentrate composition	Glyphosate g a.e./l	% w/w			
		Steareth-30	Steareth-20	Agrimul PG-2069	Aerosil 380
51-01	488	3.00			
51-02	488	4.50			
51-03	488	6.00			
51-04	488		3.00		
51-05	488		4.50		
51-06	488		6.00		
51-07	488			2.0	
51-08	488	3.00			1.5
51-09	488	4.50			1.5
51-10	488	6.00			1.5
51-11	488		3.00		1.5
51-12	488		4.50		1.5
51-13	488		6.00		1.5
51-14	488	1.50	1.50		1.5
51-15	488	2.25	2.25		1.5
51-16	488	3.00	3.00		1.5
51-17	488	2.25	2.25	2.0	1.5
51-18	488	3.00	3.00	2.0	1.5

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 23 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 51b.

Table 51b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	20
	200	22	33
	300	35	67
	400	68	73
Formulation J	100	32	63
	200	78	90
	300	83	93
	400	92	97
51-01	100	38	57
	200	50	63
	300	62	80
	400	75	89
51-02	100	20	57
	200	63	70
	300	75	88
	400	80	96
51-03	100	47	53
	200	72	80
	300	87	96
	400	100	99
51-04	100	33	30
	200	48	60
	300	75	73
	400	90	83
51-05	100	10	30
	200	43	50
	300	68	82
	400	83	92
51-06	100	22	40
	200	43	50
	300	75	83
	400	83	87
51-07	100	10	37
	200	40	63
	300	78	86
	400	95	96
51-08	100	23	43
	200	68	63
	300	92	88
	400	98	93
51-09	100	47	57
	200	78	70
	300	95	92
	400	100	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
51-10	100	37	57
	200	85	68
	300	92	85
	400	100	93
51-11	100	28	43
	200	63	73
	300	85	83
	400	95	96
51-12	100	40	53
	200	75	88
	300	90	92
	400	100	97
51-13	100	40	53
	200	75	75
	300	99	92
	400	100	98
51-14	100	30	43
	200	68	72
	300	83	82
	400	96	97
51-15	100	38	47
	200	77	72
	300	94	92
	400	100	96
51-16	100	33	43
	200	75	67
	300	92	88
	400	100	94
51-17	100	25	43
	200	68	82
	300	78	96
	400	99	96
51-18	100	13	37
	200	72	70
	300	87	80
	400	99	85

Several stabilized high-load (488 g a.e./l) glyphosate compositions of this Example provided herbicidal effectiveness equal or superior, at least on ABUTH, to that obtained with commercial standard Formulation J.

EXAMPLE 52

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 52a. Concentrate compositions 52-12 to 52-14 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 52-01 to 52-11 and 52-15 to

52-17 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Table 52a

Conc. comp.	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Ethomeen T/25	Propylene glycol	Aerosil	
52-01	488	3.0			0.8	380
52-02	488	6.0			1.5	MOX-80/MOX-170 (1:1)
52-03	488	4.5			1.5	380
52-04	488	4.5	2.25	0.5	1.5	MOX-80/380 (1:2)
52-05	488	4.5		0.5	1.5	MOX-80/380 (1:2)
52-06	488	6.0		0.5	1.5	MOX-80/380 (1:2)
52-07	488	3.0	1.50	0.5	1.5	MOX-80/380 (1:2)
52-08	488	6.0	3.00	0.5	1.5	MOX-80/380 (1:2)
52-09	488	3.0	1.50	0.5	1.5	380
52-10	488	4.5	2.25	0.5	1.5	380
52-11	488	6.0	3.00	0.5	1.5	380
52-12	488		1.50	0.5		none
52-13	488		2.25	0.5		none
52-14	488		3.00	0.5		none
52-15	488		1.50	0.5	1.5	MOX-80/380 (1:2)
52-16	488		2.25	0.5	1.5	MOX-80/380 (1:2)
52-17	488		3.00	0.5	1.5	MOX-80/380 (1:2)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 52b.

Table 52b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	3
	200	10	12
	300	43	22
	400	47	27
Formulation J	100	13	15
	200	25	22
	300	58	53
	400	68	82
52-01	100	30	20
	200	60	53
	300	73	88
	400	87	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
52-02	100	40	23
	200	63	55
	300	88	87
	400	93	93
52-03	100	42	20
	200	72	55
	300	82	83
	400	90	88
52-04	100	60	32
	200	70	57
	300	90	88
	400	90	93
52-05	100	47	32
	200	67	57
	300	88	85
	400	94	88
52-06	100	33	37
	200	68	67
	300	82	80
	400	90	88
52-07	100	35	37
	200	67	70
	300	87	85
	400	97	93
52-08	100	32	35
	200	67	77
	300	85	92
	400	97	95
52-09	100	27	33
	200	57	67
	300	88	83
	400	93	95
52-10	100	13	33
	200	62	58
	300	80	80
	400	92	92
52-11	100	13	20
	200	60	57
	300	88	63
	400	93	82
52-12	100	10	27
	200	53	53
	300	70	67
	400	88	85
52-13	100	3	28
	200	50	57
	300	67	70
	400	90	82

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
52-14	100	3	28
	200	55	57
	300	70	83
	400	87	87
52-15	100	10	20
	200	58	43
	300	70	72
	400	83	85
52-16	100	12	22
	200	55	57
	300	73	77
	400	92	90
52-16	100	7	20
	200	53	55
	300	70	75
	400	85	88

Several stabilized high-load (488 g a.e./l) glyphosate compositions of this Example provided herbicidal effectiveness equal or superior, on both ABUTH and ECHCF, to that obtained with commercial standard Formulation J.

EXAMPLE 53

Glyphosate-containing spray compositions were prepared by tank-mixing Formulation B with excipients as shown in Table 53.

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application. Results, averaged for all replicates of each treatment, are shown in Table 53.

Table 53

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	none		18	25
	250			73	58
	350			80	82
Formulation J	150	none		47	90
	250			77	93
	350			95	94
Formulation B	150	steareth-10	1:0.3	53	88
	250			83	94
	350			98	98
Formulation B	150	steareth-10	1:1	48	73
	250			67	97
	350			93	99

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	steareth-10	1:1.5	52	60
	250			65	95
	350			86	99
Formulation B	150	steareth-10	1:3	48	73
	250			65	83
	350			80	98
Formulation B	150	steareth-10	1:6	50	81
	250			60	87
	350			85	97
Formulation B	150	steareth-20	1:0.3	76	92
	250			100	93
	350			100	99
Formulation B	150	steareth-20	1:1	65	75
	250			94	96
	350			99	99
Formulation B	150	steareth-20	1:1.5	52	95
	250			84	92
	350			98	98
Formulation B	150	steareth-20	1:3	53	82
	250			82	100
	350			98	93
Formulation B	150	steareth-20	1:6	47	62
	250			68	93
	350			92	97
Formulation B	150	steareth-30	1:0.3	63	88
	250			97	100
	350			100	100
Formulation B	150	steareth-30	1:1	53	72
	250			88	96
	350			97	97
Formulation B	150	steareth-30	1:1.5	50	79
	250			81	89
	350			96	100
Formulation B	150	steareth-30	1:3	50	67
	250			78	88
	350			97	91
Formulation B	150	steareth-30	1:6	47	58
	250			75	99
	350			89	99
Formulation B	150	ceteareth-30	1:0.3	55	86
	250			89	91
	350			99	100
Formulation B	150	ceteareth-30	1:1	50	86
	250			85	95
	350			97	100
Formulation B	150	ceteareth-30	1:1.5	43	75
	250			80	100
	350			88	98

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	ceteareth-30	1:3	33	73
	250			60	92
	350			94	100
Formulation B	150	ceteareth-30	1:6	37	73
	250			53	89
	350			88	100
Formulation B	150	Ethomeen T/25	1:0.3	67	90
	250			92	99
	350			100	100
Formulation B	150	Ethomeen T/25	1:1	58	94
	250			83	96
	350			93	98
Formulation B	150	Ethomeen T/25	1:1.5	50	73
	250			86	100
	350			99	100
Formulation B	150	Ethomeen T/25	1:3	45	83
	250			89	95
	350			100	100
Formulation B	150	Ethomeen T/25	1:6	35	82
	250			73	98
	350			88	98

Steareth-20, steareth-30 and ceteareth-30 were more effective additives for Formulation B than steareth-10 in this study.

The preceding description of specific embodiments of the present invention is not intended to be a complete list of every possible embodiment of the invention. Persons skilled in this field will recognize that modifications can be made to the specific embodiments described here that would be within the scope of the present invention.

With reference to the use of the word(s) "comprise" or "comprises" or "comprising" in the foregoing description and/or in the following claims, unless the context requires otherwise, those words are used on the basis and clear understanding that they are to be interpreted inclusively, rather than exclusively, and that each of those words to be so interpreted in construing the foregoing description and/or the following claims.

The claims defining the invention are as follows:

1. A plant treatment composition comprising (a) an exogenous chemical selected from glyphosate and herbicidal derivatives thereof and (b) an alkylether surfactant or mixture of such surfactants having the formula

$$R^{12}\text{-}O\text{-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13}$$

wherein R^{12} is an alkyl or alkenyl group having 16 to 22 carbon atoms, n is an average number of 10 to 100, m is an average number of 0 to 5, and R^{13} is hydrogen or C_{1-4} alkyl, present in an amount such that the weight/weight ratio of said alkylether surfactant or mixture of such surfactants to the exogenous chemical is 1:3 to 1:100.

2. The composition of claim 1, wherein m is 0 and R^{13} is hydrogen.

3. The composition of claim 1 or 2, wherein n is from 20 to 40.

4. The composition of any one of claims 1 to 3, wherein R^{12} is a saturated straight-chain alkyl group.

5. The composition of claim 4, wherein the alkylether surfactant is a cetyl or stearyl ether or mixture thereof.

6. The composition of any one of claims 1 to 5, further comprising water and an amount of a solid inorganic particulate colloidal material effective to stabilize the composition, said composition not exhibiting phase separation over a period of time T when stored in a closed container at a temperature in the range from 15°C to 30°C, T being in the range from 1 hour to 60 days; wherein the exogenous chemical and the surfactant are present at concentrations in the absolute or relative to each other such that, in the absence of the colloidal material, phase separation would occur during said period of time T.

7. The composition of claim 6 wherein the colloidal material comprises particulates selected from the group consisting of silicon oxides, aluminum oxides, titanium oxides, and mixtures thereof.

8. The composition of claim 6 wherein the particulate colloidal material has an average specific surface area of 50 to 400 m^2/g.

9. The composition of claim 7 wherein the particulate colloidal material has an average specific surface area of 180 to 400 m^2/g.

10. The composition of claim 6 wherein the particulate colloidal material has a bimodal distribution of specific surface area whereby a first component of the colloidal material has an average specific surface area of 50 to 150 m^2/g and a second component of the colloidal material has an average specific surface area of 180 to 400 m^2/g.

11. The composition of any one of claims 1 to 10, further comprising a compound of formula

$$R^{14}\text{-}CO\text{-}A\text{-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having 5 to 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is 11 to 27, and A is O or NH.

12. The composition of claim 11 wherein said compound is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

13. The composition of claim 11 wherein said compound is a C_{1-4} alkyl ester of a saturated C_{12-18} fatty acid.

14. The composition of claim 11 wherein said compound is a butyl stearate.

15. The composition of any one of the preceding claims wherein the exogenous chemical is selected from the group consisting of sodium, potassium, ammonium, mono-, di-, tri- and tetra-C_{1-4}-alkylammonium, mono-, di- and tri-C_{1-4}-alkylsulfonium and sulfoxonium salts of glyphosate.

16. The composition of any one of the preceding claims wherein the exogenous chemical is selected from the group consisting of the ammonium, monoisopropylammonium or trimethylsulfonium salt of glyphosate.

17. The composition of any one of claims 1 to 16, further comprising water in an amount effective to make the composition a dilute aqueous composition ready for application to foliage of a plant.

18. The composition of any one of claims 1 to 16, wherein the composition is a shelf-stable concentrate composition comprising the exogenous chemical in an amount of 15 to 90 percent by weight.

19. The composition of any one of claims 1 to 16, wherein the composition is a shelf-stable concentrate composition comprising a liquid diluent and the exogenous chemical in an amount of 15 to 60 percent by weight.

20. The composition of claim 18, wherein the composition is a solid composition comprising the exogenous chemical substance in an amount of 30 to 90 percent by weight.

21. A plant treatment method, comprising contacting foliage of a plant with a biologically effective amount of a composite according to any one of claims 1 to 20.

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