HERBICIDE AND METHOD FOR CONTROLLING WEEDS


Notice: The portion of the term of this patent subsequent to Mar. 18, 1992, has been disclaimed.

Filed: June 1, 1971
Appl. No.: 148,925

U.S. Cl. 71/106, 71/111, 71/118
Int. Cl. A01N 9/20
Field of Search 71/111, 118

References Cited
UNITED STATES PATENTS
2,776,196 1/1957 Gysin et al. 71/111 X
2,776,197 1/1957 Gysin et al. 71/111 X
2,812,247 11/1957 Gysin et al. 71/111 X
3,547,620 12/1970 Olin 71/118

FOREIGN PATENTS OR APPLICATIONS
1,186,472 4/1970 United Kingdom 71/111

OTHER PUBLICATIONS

Primary Examiner—James O. Thomas, Jr.
Attorney, Agent, or Firm—George D. Morris

ABSTRACT
Herbicidal compositions containing (1) an alkyl N-phenylcarbamate, (2) 2-chloro-2', 6'-diethyl-N-methoxyacetic anilide, and (3) an aryl N-alkylcarbamate, an aryl N,N-diarylcarbamate, or an aryl N-cycloalkylcarbamate are disclosed. An exemplary composition contains isopropyl N-(3-chlorophenyl)carbamate, 2-chloro-2', 6'-diethyl-N-(methyl)acetanilide, and 4-chlorophenyl N-methylcarbamate. These compositions are generally used for pre-emergent applications. The compounds may be applied together or separately.

20 Claims, No Drawings
HERBICIDE AND METHOD FOR CONTROLLING WEEDS

This invention relates to herbicidal compositions which contain at least one compound of each of the three following classes of compounds: (1) an alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates (Class 1); (2) 2-chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide (Class 2) and (3) a compound which is an aryl N-alkylcarbamate, and aryl N,N-dialkylcarbamate, an aryl N-cycloalkylcarbamate, or mixtures thereof (Class 3).

The alkyl N-phenylcarbamates suitable for use in this invention may be represented by the structural formula:

\[
\begin{align*}
R_1 & \text{OCNH} \quad \text{X}_1 \quad \text{X}_2 \\
\text{X}_3 & \quad \text{X}_4 \\
\end{align*}
\]

wherein \( R_1 \) is an unsubstituted alkyl or haloalkyl radical and \( \text{X}_1, \text{X}_2, \text{X}_3, \text{X}_4 \) and \( \text{X}_5 \) are each independently hydrogen or halogen. The halogen substituents may be fluorine, chlorine, bromine, or iodine. Chlorine is preferred. The alkyl or haloalkyl radical usually contains from 1 to 8 carbon atoms although more may be used if desired. Most often the alkyl radical or haloalkyl radical contains from 1 to 3 carbon atoms. The aryl groups are preferred. Exemplary compounds are:

- methyl N-phenylcarbamate
- ethyl N-phenylcarbamate
- propyl N-phenylcarbamate
- isopropyl N-phenylcarbamate
- butyl N-phenylcarbamate
- isobutyl N-phenylcarbamate
- sec-butyl N-phenylcarbamate
- tert-butyl N-phenylcarbamate
- phenyl N-phenylcarbamate
- 2,3-dimethylpropyl N-phenylcarbamate
- 3,3,4-trimethylpentyl N-phenylcarbamate
- octyl N-phenylcarbamate
- methyl N-(chlorophenyl)carbamate
- ethyl N-(2,5-dichlorophenyl) carbamate
- isopropyl N-(3-chlorophenyl) carbamate
- isopropyl N-(3-fluorophenyl) carbamate
- isopropyl N-(3-iodophenyl) carbamate
- butyl N-(2-chloro-14-bromophenyl) carbamate
- chloromethyl N-phenylcarbamate
- 3-bromobutyl N-phenylcarbamate
- 2,3-dichlorophenyl N-phenylcarbamate
- dichloromethyl N-(3-chlorophenyl) carbamate
- 1,2-dichloroethyl N-(4-bromophenyl) carbamate

Of particular importance are the compounds isopropyl N-phenylcarbamate represented by the structural formula:

\[
\begin{align*}
\text{CH}_3 & \text{OCN} \\
\text{CH}_2 & \text{CH}_3
\end{align*}
\]

and isopropyl N-(3-chlorophenyl)carbamate represented by the structural formula:

\[
\begin{align*}
\text{CH}_3 & \text{OCN} \\
\text{CH}_2 & \text{CH}_3
\end{align*}
\]

The alkyl N-phenylcarbamates -chloro- be prepared by the reaction of the appropriate alkyl haloformate and the appropriate aniline. Such reactions are well known as exemplified by U.S. Pat. Nos. 2,615,916 and 2,965,225.

The 2-chloro-2',6'-diethyl N-(methoxymethyl)-acetanilide may be represented by the structural formula:

\[
\begin{align*}
\text{CH}_2 & \text{CH}_3 \\
\text{N} & \text{OCH}_2 \text{Cl}
\end{align*}
\]

This compound may be prepared by reacting chloroacetyl chloride with 2,6-diethyl-N-methyleneamine to form 2-chloro-2',6'-diethyl-N-(chloromethyl)acetanilide which is then reacted with methyl alcohol. These reactions are well known as exemplified by U.S. Pat. No. 3,442,945, particularly column 3, lines 31-48 and Example 5 thereof.

The aryl N-alkylcarbamates, aryl N,N-dialkylcarbamates, aryl N-cycloalkylcarbamates, and aryl N-cycloalkyl N-alkylcarbamates may be represented by the structural formula:

\[
\begin{align*}
\text{Aryl} & \text{OCN} \\
\text{R}_2 & \text{OR}_3
\end{align*}
\]

wherein

- Aryl is a phenyl, substituted phenyl, naphthyl, or substituted naphthyl radical;
- \( R_2 \) is hydrogen, an unsubstituted alkyl radical, or a haloalkyl radical; and
- \( R_3 \) is an unsubstituted alkyl, haloalkyl, or cycloalkyl radical.

The halogen substituents may be fluorine, chlorine, bromine, or iodine. Chlorine is preferred. The aryl group is unsubstituted or may be substituted by halogen or by alkyl which usually contains from 1 to 8 carbon atoms. From 1 to 3 carbon atoms is more typical.

When Aryl is naphthyl, it may be either 1-naphthyl or 2-naphthyl. The 1-naphthyl radical is preferred. This applies whether the naphthyl radical is substituted or unsubstituted.

When \( R_2 \) is unsubstituted alkyl or haloalkyl, it usually contains from 1 to 8 carbon atoms. From 1 to 4 carbon atoms are more typical. From 1 to 3 carbon atoms are preferred.

When \( R_3 \) is unsubstituted alkyl or haloalkyl, it usually contains from 1 to 8 carbon atoms. From 1 to 4 carbon atoms are typical. From 1 to 3 carbon atoms are preferred.
When R₃ is cycloalkyl, it usually contains from 3 to 8 carbon atoms. From 6 to 8 carbon atoms is typical. Cyclohexyl is preferred.

Exemplary compounds are:

- phenyl N-methylcarbamate
- phenyl N-ethylcarbamate
- phenyl N-propylcarbamate
- phenyl N-isopropylcarbamate
- phenyl N-butylcarbamate
- phenyl N-isobutylcarbamate
- phenyl N-n-propylcarbamate
- phenyl N-tert-butylcarbamate
- phenyl N-hexylcarbamate
- phenyl N-octylcarbamate
- phenyl N-cyclohexylcarbamate
- 2-chlorophenyl N-methylcarbamate
- 2-chlorophenyl N-ethylcarbamate
- 2-chlorophenyl N-isopropylcarbamate
- 2-chlorophenyl N-butylcarbamate
- 3-chlorophenyl N-methylcarbamate
- 3-chlorophenyl N-ethylcarbamate
- 3-chlorophenyl N-propylcarbamate
- 3-chlorophenyl N-isopropylcarbamate
- 3-chlorophenyl N-butylcarbamate
- 3-chlorophenyl N-isobutylcarbamate
- 3-chlorophenyl N-n-propylcarbamate
- 3-chlorophenyl N-tert-butylcarbamate
- 3-chlorophenyl N-pentylcarbamate
- 3-chlorophenyl N-octylcarbamate
- 4-chlorophenyl N-methylcarbamate
- 4-chlorophenyl N-ethylcarbamate
- 4-chlorophenyl N-propylcarbamate
- 4-chlorophenyl N-isopropylcarbamate
- 4-chlorophenyl N-butylcarbamate
- 4-chlorophenyl N-isobutylcarbamate
- 4-chlorophenyl N-n-propylcarbamate
- 4-chlorophenyl N-tert-butylcarbamate
- 4-chlorophenyl N-pentylcarbamate
- 4-chlorophenyl N-hexylcarbamate
- 4-chlorophenyl N-cyclohexylcarbamate
- 4-chlorophenyl N-(3-methylpentyl)carbamate
- 4-chlorophenyl N-heptylcarbamate
- 4-chlorophenyl N-octylcarbamate
- 4-chlorophenyl N-(2-ethylhexyl)carbamate
- 4-chlorophenyl N-cyclohexylcarbamate
- 4-bromophenyl N-methylcarbamate
- 4-bromophenyl N-ethylcarbamate
- 4-bromophenyl N-propylcarbamate
- 4-bromophenyl N-isopropylcarbamate
- 4-fluorophenyl N-methylcarbamate
- 2,3-dichlorophenyl N-methylcarbamate
- 2,3-dichlorophenyl N-ethylcarbamate
- 2,3-dichlorophenyl N-propylcarbamate
- 2,3-dichlorophenyl N-n-propylcarbamate
- 2,3-dichlorophenyl N-hexylcarbamate
- 2,3-dichlorophenyl N-cyclohexylcarbamate
- 2,4-dichlorophenyl N-methylcarbamate
- 2,4-dichlorophenyl N-ethylcarbamate
- 2,4-dichlorophenyl N-butylcarbamate
- 2,4-dichlorophenyl N-n-propylcarbamate
- 2,4-dichlorophenyl N-tert-butylcarbamate
- 2,4-dichlorophenyl N-(2,3-dimethylpentyl)carbamate
- 2,4-dichlorophenyl N-cyclopropylcarbamate
- 2,5-dichlorophenyl N-methylcarbamate
- 2,5-dichlorophenyl N-ethylcarbamate
- 2,6-dichlorophenyl N-methylcarbamate
- 2,6-dichlorophenyl N-ethylcarbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-tert-butylcarbamate
- 2,6-dichlorophenyl N-hexylcarbamate
- 2,6-dichlorophenyl N-cyclohexylcarbamate
- 2,6-dichlorophenyl N-(2,3-dimethylpentyl)carbamate
- 2,6-dichlorophenyl N-cyclopropylcarbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-tert-butylcarbamate
- 2,6-dichlorophenyl N-n-butylcarbamate
- 2,6-dichlorophenyl N-(3-chloropropyl)carbamate
- 2,6-dichlorophenyl N-(2-chloroethyl)carbamate
- 2,6-dichlorophenyl N-(2-chloromethyl)carbamate
- 2,6-dichlorophenyl N-(3-chloropropyl)carbamate
- 2,6-dichlorophenyl N-(2-chloroethyl)carbamate
- 2,6-dibromophenyl N-propylcarbamate
- 2,3,5-trichlorophenyl N-methylcarbamate
- 2,3,6-trichlorophenyl N-ethylcarbamate
- 2,3,4,6-tetrachlorophenyl N-methylcarbamate
- 2,3,4,5,6-pentachlorophenyl N-methylcarbamate
- 2,6-dichlorophenyl N-sec-butylcarbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-pentylcarbamate
- 2,6-dichlorophenyl N-octylcarbamate
- 2,6-dichlorophenyl N-cyclooctylcarbamate
- 2,6-dichlorophenyl N-heptylcarbamate
- 2,6-dichlorophenyl N-n-butylcarbamate
- 2,6-dichlorophenyl N-(3-chloropropyl)carbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-tert-butylcarbamate
- 2,6-dichlorophenyl N-hexylcarbamate
- 2,6-dichlorophenyl N-cyclohexylcarbamate
- 2,6-dichlorophenyl N-(2,3-dimethylpentyl)carbamate
- 2,6-dichlorophenyl N-cyclopropylcarbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-tert-butylcarbamate
- 2,6-dichlorophenyl N-n-butylcarbamate
- 2,6-dichlorophenyl N-(3-chloropropyl)carbamate
- 2,6-dichlorophenyl N-n-propylcarbamate
- 2,6-dichlorophenyl N-tert-butylcarbamate
4-chlorophenyl N-(3-bromobutyl)carbamate
2,3-dichlorophenyl N-chloromethylcarbamate
2,4-dichlorophenyl N-dichloromethylcarbamate
2,3,4,5,6-pentachloro N-trichloromethylcarbamate
phenyl N,N-bis(chloromethyl)carbamate
phenyl N-methyl N-chloromethylcarbamate
2-chlorophenyl N-ethyl N-dichloromethylcarbamate
3-chlorophenyl N,N-bis(chloromethyl)carbamate
4-chlorophenyl N,N-bis(chloromethyl)carbamate
4-chlorophenyl N-methyl N-chloromethylcarbamate
4-chlorophenyl N-ethyl N-chloromethylcarbamate
4-chlorophenyl N,N-bis(2-chloroethyl)carbamate
4-chlorophenyl N-chloromethyl N-(2-chloroethyl)-carbamate
4-chlorophenyl N-(1,2-dichloroethyl) N perchloropropyl carbamate
2,4-dichlorophenyl N-methyl N-(2,2-dichloroethyl)-carbamate
2,3,5-trichlorophenyl N,N-bis(trichloromethyl)carbamate
1-naphthyl N-methylcarbamate
1-naphthyl N-ethylcarbamate
1-naphthyl N-propylcarbamate
1-naphthyl N-isopropylcarbamate
1-naphthyl N-butylcarbamate
1-naphthyl N-isobutylcarbamate
1-naphthyl N-sec-butylcarbamate
1-naphthyl N-tert-butylcarbamate
1-naphthyl N-pentylcarbamate
1-naphthyl N-hexylcarbamate
1-naphthyl N-octylcarbamate
1-naphthyl N-cyclohexylcarbamate
3-chloro-1-naphthyl N-methylcarbamate
3-chloro-1-naphthyl N-ethylcarbamate
4-chloro-1-naphthyl N-methylcarbamate
6-chloro-1-naphthyl N-ethylcarbamate
1-naphthyl N,N-dimethylcarbamate
1-naphthyl N,N-diethylcarbamate
1-naphthyl N,N-diisopropylcarbamate
3-chloro-1-naphthyl N,N-dimethylcarbamate
7-chloro-1-naphthyl N,N-diethylcarbamate
4-chloro-1-naphthyl N-chloromethylcarbamate
4-chloro-1-naphthyl N,N-bis(chloromethyl)carbamate
2-naphthyl N-methylcarbamate
2-naphthyl N-ethylcarbamate
2-naphthyl N-isopropylcarbamate
2-naphthyl N-butylcarbamate
2-naphthyl N-octylcarbamate
3-chloro-2-naphthyl N-methylcarbamate
3,6,7-trichloro-2-naphthyl N-ethylcarbamate
2-naphthyl N,N-dimethylcarbamate
2-naphthyl N,N-diethylcarbamate
2-naphthyl N,N-diisopropylcarbamate
3,6,7-chloro-2-naphthyl N,N-dimethylcarbamate Pat.
4-chloro-2-naphthyl N-methyl N-chloromethylcarbamate
6-chloro-2-naphthyl N,N-bis(2-chloroethyl)carbamate

Of particular importance are the compounds: phenyl N-methylcarbamate,

4-chlorophenyl N-methylcarbamate,
gence herbicides but may be applied to the soil or plant for post-emergence herbicidal purposes.

A single composition containing members of the three classes may be applied to the soil or plant. Alternatively, the members may be applied separately within a reasonable interval of time which will allow cooperation between the members to produce the desired effect. Of course, the members may be combined in various ways for application, as, for example, separate applications of a member of one class and a combination of members of the remaining two classes may be made.

In one embodiment of this invention the herbicidal composition may be used for control of weeds by pre-emergent applications. In one form of pre-emergent application, the composition is applied to the soil and/or weeds subsequent to seeding the crop plants but prior to the emergence of the crop seedling through the soil. While the amounts applied are ordinarily as hereinafter described, it may generally be stated that greater amounts of the composition may be used as the crop seed is positioned deeper in the soil.

In another embodiment, the formulation is applied to the soil close to, but not directly above the seed. This may be achieved for no crops by applying the formulation as one or more sidebands.

In still another embodiment, the formulation is applied as a layer below the surface of the soil. The layer may conveniently be located above or below the seed, depending upon the tolerance of the seed. Subsoil layering can also be used for the control of perennial weeds growing with established herbaceous or woody crops.

In another form of pre-emergent application, the composition is applied to the soil and/or weeds concurrently with the application of the crop seed. Here the seed and composition may be applied by separate systems or the seed and the composition may be mixed and applied by the same system. When the composition and seeds are mixed prior to application, it is usually desirable that the herbicidal composition derivative be in the form of a flowable solid such as crystals, powder, or granules.

In a further form of pre-emergent application, the herbicidal composition is incorporated in the soil or applied to the soil and/or weeds prior to the planting of crops. This method permits additional flexibility because amounts of composition in excess of the amount which would kill or retard the crop plant may be applied if desired. Sufficient time is then allowed for the composition concentration to abate to safe levels. Crop plants or seeds may then be set out. The pre-plant soil incorporate method is often used to achieve control of deep-germinating weeds.

It is often advantageous to apply the herbicidal composition post-emergence to the area containing weeds and crop plants which have emerged from the soil. In this fashion, some weeds are selectively killed without significant damage to crop plants. The selectivity effect is enhanced if the crop plants are well established whereas the weeds are not.

In a further form of post-emergence application, the herbicidal composition is applied to the area containing weeds and crop plants which have emerged from the soil. The application rate is adjusted so that the growth of the weeds is inhibited while the crop plant suffers no significant damage. The rate of application is generally less than when a killing of the weeds is desired.

The amounts of the three classes which are applied in the above embodiments may vary widely. The amount of Class 1 applied usually is in the range of from 0.1 to 50 pounds per acre. Usually the amount is in the range of from 0.5 to 20 pounds per acre. A range of from 1 to 10 pounds per acre is preferred. The amount of Class 2 applied is usually in the range of from 0.1 to 50 pounds per acre. Ordinarily the amount is in the range of from 0.5 to 20 pounds per acre. A range of from 1 to 10 pounds per acre is preferred. The amount of Class 3 applied usually ranges from 1 to 100 percent of the rage at which Class 1 is applied. Typically the application is in the range of 4 to 50 percent. A range of from 5 to 30 percent is preferred. While these general ranges of application are applicable to the above embodiments, it is recognized that both the optimum and useful amounts will vary depending upon the plant crop involved, the weeds encountered, the particular compounds used, the soil condition, cultivation practices, and the effect desired. The Examples give an even better indication of the amounts of the classes which may advantageously be used when dealing with certain weeds.

The proportions of the classes in a composition containing the three classes may also vary widely. Generally speaking, the herbicidal composition contains herbicidally effective amounts of both the alkyl N-phenyl carbamate or mixtures thereof and the 2-chloro-2,6-dimethyl N-(methoxyethyl)acetanilide and, further, an aryl N-alkylcarbamate, an aryl N,N-dialkylcarbamate, an aryl N-cycloalkylcarbamate, or mixtures thereof in an amount sufficient to extend the soil life of the alkyl N-phenyl carbamate. Typically, the Class 1/Class 2 weight ratio is in the range of from 1:500 to 500:1. A range of from 1:40 to 40:1 is more usual. The preferred range is from 1:10 to 10:1. Equal amounts are commonly employed. The Class 1/Class 3 weight ratio is ordinarily in the range of from 1:1 to 100:1. A range of from 2:1 to 25:1 is typical. The preferred range is from 3:1 to 20:1.

The herbicidal composition may be formulated in many ways. Convenient formulations include granular formulations, wettable powders, solutions, and emulsions. These formulations may be prepared in accordance with the general techniques well known to the art. These formulations may be applied directly to the soil and/or weeds or they may be diluted before application.

Generally speaking, formulations contain from about 0.1 to 100 percent by weight members of the three classes constituting collectively what may be termed "actives." Often formulations contain from about 1 to about 50 percent by weight actives. Of course, the precise amount will depend upon such factors as the type of formulation employed, the type of application, and the mode of application.

Suitable wettable powders typically contain from about 1 to about 100 percent by weight actives. Ordinarily, wettable powders contain from 10 to 85 percent by weight actives. The actives may be mixed with an inert powder such as silica, chalk, talc, limestone, or clay. Any convenient amount of diluent may be used, from about 15 to about 90 percent being typical. Small amounts of dispersing and/or wetting agents are usually included in the formulations. These usually range from 0.1 to 15 percent by weight of the formulation. Ordinarily amounts ranging from 1 to 12 percent are used.
The wettable powder is typically dispersed in water for application. Solutions of the actives may be prepared. Ordinarily concentrated solutions are prepared which, when diluted with water for application, form emulsions. Solvents suitable for use are numerous and include many well known for their solvency powers. Examples include the xylenes, toluene, methyl alcohol, ethyl alcohol, isopropyl alcohol, the butyl alcohols, water, gasoline, kerosene diethyl ether, methyl ethyl ether, ethylene glycol, propylene glycol, n-amyl acetate, allyl alcohol, cellulose, methyl acetate, ethyl acetate, acetone, methyl ethyl ketone, methyl isobutyl ketone, benzene, methyl naphthalene, ethyl naphthalene, and edible oils such as corn oil, olive oil, cod liver oil, cottonseed oil, safflower oil, soybean oil, and peanut oil.

The formulations of the present invention frequently include small amounts of various surfactants such as wetting agents, emulsifiers, and dispersants. Anionic surfactants are used for wettable powders. Emulsifiable concentrates generally contain blends of ionic and anionic surfactants. Many surfactants are available as commercial products. Well known dispersing agents which are useful in wettable powders include the lignin surfactants (ligno sulfonates) such as those described in U.S. Pat. No. 2,491,832, and the alkaryl sulfonates. The ligno sulfonates of most interest are the metallic, notably the sodium and calcium, sulfonate salts. Molecular weights of these materials normally range from about 1,000 to about 20,000. Another useful class of surfactants comprises the formaldehyde-naphthalene sulfonate condensates typified by those disclosed in U.S. Pat. No. 2,516,095. Other useful dispersing agents are found among the alkali metal derivatives of unsaturated and aromatic hydrocarbons, the akali metal alcohohlates of long chain alcohols, and the anhydrous alkali metal soaps of higher fatty acids. Particularly suitable wetting agents for wettable powders are the taurates typified by sodium N-methyl-N-oleyl taurate. Sodium alkyl naphthalene sulfonates and the oleic acid quats of sodium isothionate are also especially useful. The condensation products of alkylene oxides with phenols and organic acids, the polyalkylene derivatives of sorbitan esters, complex ether alcohols, and mahogany soaps are examples of useful ionic surfactants. Other surface active agents of the same or similar physical properties are known to the art and can be employed in the formulations of this invention.

It is often desirable to include in a formulation which is to be mixed with water, a small amount, e.g., about 1/10 to about 1 per cent by weight of a suitable anti-foaming agent. Useful anti-foaming agents include the diteriary acetylene glycols, such as those marketed under the tradename SURFYNOL by Air Reduction Chemical and Carbide Company, 150 E. 42nd Street, New York, N.Y. 10017. Other compounds known to the art to function as anti-foaming agents may be employed if desired. Such compounds include 2-octanol, sulfonated oils, and silicones. Useful silicones are those of low molecular weight, i.e., the silicone fluids or oils. Typical of these are the methyl and ethyl substituted silicone such as the dimethyl silicones.

Many of the solvents, solvent systems, and wetting agents are discussed in U.S. Pat. Nos. 2,695,225 and 3,330,642 and Canadian Pat. No. 851,658.

The amount of actives in liquid formulations, include both single phase solutions and emulsions containing

| Isopropyl N-(3-chlorophenyl)carbamate | 33.5% w/w |
| 2-Chloro-2',6'-diethyl-N-(methoxyethyl)-acetanilide | 3.5 |
| 4-Chlorophenyl N-methylcarbamate | 8.3 |
| Xylene | 14.1 |
| ATLOX 3421F | 4.5 |
| ATLOX 3422F | 1.5 |
| Inert | 4.6 |

Granular formulations may be prepared by spraying molten mixtures of the three classes directly onto an inert carrier. The classes may be applied sequentially if desired as a melt. In another method, a liquid formulation, either a solution or an emulsion, may be applied to the inert carrier particles. For instance, the formulation exemplified in the previous paragraph is suitable for application to inert carrier particles. Formulations of the three classes may also be applied sequentially. As an example, a solution of 2-chloro-2',6'-diethyl N-(methoxyethyl)acetanilide dissolved in xylene may be applied to inert carrier particles, after which the impregnated particles are dried. Isopropyl N-(3-chlorophenyl)carbamate and 4-chlorophenyl N-methylcarbamate dissolved in an organic solvent such as xylene are then applied to the particles. If desired, the isopropyl N-(3-chlorophenyl)carbamate and the 4-chlorophenyl N-methylcarbamate may be applied as separate solutions. Many types of inert carrier particles are suitable for use in the instant invention. Among these are attapulgite, montmorillonite, bentonite, vermiculite, corn cobs, and sawdust. The actives ordinarily constitute from about 0.5 to about 50 percent by weight of these granular products. Typically, the ac-
The compositions of the invention are especially suitable for the elimination of weeds in onion patches and soybean fields. Seeded onion patches are ordinarily treated pre-emergence the onion plants and once or twice after the onions have emerged. Seeded soybean fields are ordinarily treated pre-emergence to the soybean plants.

**EXAMPLE I**

Sandy loam soil having (1) a mechanical analysis of 62 percent sand, 30 percent silt and 8 percent clay, (2) an inherent organic matter level of 3.6 percent, and (3) of pH of 6.1 was modified by adding 2.0 percent by weight peat, 5.3 percent by weight dried cow manure, and sufficient lime to increase the pH to approximately 7.0. The modified soil was sprayed with solutions of the test compounds. For each pound per acre reported in the results, 5.5 micrograms of test compound were applied to 1 gram of soil. The test compounds were then incorporated into the soil by mechanical blenders. The treated soil and untreated control soil were stored under moist conditions at room temperature. Alliquots of soil were removed from each soil 1, 2, 4 and 8 weeks after treatment and placed in a 3 inch by 3 inch pot over a layer of untreated, sterilized soil. The depth of the treated soil in the pot was 3/4 inch. Each pot was then seeded with test plants. After a growing period of approximately 4 weeks, the herbicidal effectiveness of the test composition was evaluated and the results reported on a scale ranging from 0 (no injury) to 10 (all plants killed). The results are shown in Table 1 where the test compositions are rates of application are identified according to the following key:

<table>
<thead>
<tr>
<th>Identification Code</th>
<th>Components</th>
<th>Rate, lb/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4-Chlorophenol N-methylcarbamate</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>Isopropyl N-(3-chlorophenol)carbamate</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>2-Chloro-2',6'-diethyl N-(methoxymethyl) acetanilide</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>2-Chloro-2',6'-diethyl N-(methoxymethyl) acetanilide</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>Isopropyl N-(3-chlorophenol)carbamate</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>2-Chloro-2',6'-diethyl N-(methoxymethyl) acetanilide</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>Isopropyl N-(3-chlorophenol)carbamate</td>
<td>4</td>
</tr>
<tr>
<td>H</td>
<td>4-Chlorophenol N-methylcarbamate</td>
<td>1</td>
</tr>
</tbody>
</table>

The test plants used are identified according to the following key:

<table>
<thead>
<tr>
<th>Identification Code</th>
<th>Test Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>QKGS</td>
<td>Quackgrass (Agropyron repens [L.] Beauv.)</td>
</tr>
<tr>
<td>WOAT</td>
<td>Wild oats (Avena fatua L.)</td>
</tr>
<tr>
<td>BNGS</td>
<td>Barnyardgrass (Echinochloa crusgalli [L.] Beauv.)</td>
</tr>
<tr>
<td>CBGS</td>
<td>Crabgrass (Digitaria sanguinalis Soop.)</td>
</tr>
<tr>
<td>BKWT</td>
<td>Buckwheat (Polygonum convolvulus L.)</td>
</tr>
<tr>
<td>MNGY</td>
<td>Morning glory (Mixture of Ipomoea purpurea Roth and Ipomoea hederacea Jacq.)</td>
</tr>
</tbody>
</table>

**TABLE 1**

<table>
<thead>
<tr>
<th>Test Composition and Rate</th>
<th>Interval Weeks</th>
<th>Injury Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QKGS</td>
<td>WOAT</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>H</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>I</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>J</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>L</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>M</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>N</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>O</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>P</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>R</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>S</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>U</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>V</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>W</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>X</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Y</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>
### Table 2

**BIOASSAY OF HERBICIDAL COMPOSITIONS USING SEVERAL TEST PLANTS**

<table>
<thead>
<tr>
<th>Test Composition and Rate</th>
<th>Interval, Weeks</th>
<th>Injury Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZKGS</td>
<td>WOAT</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>I</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>H</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>I</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>H</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>I</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>A</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>H</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

### Table 3

**Field Trials of Various Herbicidal Compositions**

<table>
<thead>
<tr>
<th>Test Compound</th>
<th>Compositions Applied</th>
<th>Rate, lb/A</th>
<th>Percent Control of Broadleaf</th>
<th>Percent Control of Foxtail</th>
<th>Major Species</th>
<th>Yield, Bushels/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>2.5</td>
<td>5</td>
<td>5</td>
<td>-41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>0.625</td>
<td>85</td>
<td>86</td>
<td>Velvetleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl N-(Methoxymethyl)-Acetanilide</td>
<td>1</td>
<td>5</td>
<td>-19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>2.5</td>
<td>5</td>
<td>5</td>
<td>-41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>0.625</td>
<td>85</td>
<td>86</td>
<td>Velvetleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>5.0</td>
<td>5</td>
<td>38</td>
<td>-42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>1.25</td>
<td>81</td>
<td>82</td>
<td>Velvetleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl N-(Methoxymethyl)-Acetanilide</td>
<td>1</td>
<td>85</td>
<td>86</td>
<td>Velvetleaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>5.0</td>
<td>5</td>
<td>38</td>
<td>-42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>1.25</td>
<td>100</td>
<td>100</td>
<td>-54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE IV

A single-herbicide study and a herbicide combination study were conducted in separate but adjacent field studies on the same plot area which is composed of Weir silt loam having 1.0 percent organic matter. A randomized complete block design with three replications was used for each study. Individual plots were 35 feet long, 4 rows wide, with a 30-inch row spacing. Three of the four rows were treated, the fourth serving as a weedy check. A four-row weedy and a four-row weed-free plot were included in each of the studies. Preplant incorporate (PPI) treatments of both single herbicides and herbicide combinations were applied in the late spring and immediately incorporated with a tandem disc to a depth of 3 to 4 inches followed by a spike-tooth harrow. Soybeans (Glycine max L. var. Clark 63) were planted in both the preplant incorporate test area and in the area where the single-herbicide preemergence (PE) treatments were to be applied. The preemergence treatments using single herbicides were applied on the same day, hereinafter referred to as the base day. One day after the base day, several other plots were planted in the same variety of soybeans and immediately thereafter the pre-emergence treatments of herbicide combinations were applied. All treatments were applied in 20 gallon of water per acre. All plots were visually rated for weeds 40 days after the base day. The four-row weedy check and the weedy single rows associated with each plot were used in evaluating the three treated rows. Observations continued throughout the season and a weed count in the four-row weedy check plot was made 92 days after the base day. This weed count is presented in Table 4. Ten feet of the middle treated row was harvested 134 days after the base day. All yields are converted to a uniform 18.0 percent moisture basis. The identity of the test compounds, their rates and modes of application, weed control, crop injury and yields are shown in Tables 5 and 6 for single herbicides and herbicide combinations, respectively.

| Table 4 | Weed Species Populations in the Four-Row Weedy Check Plots in Weeds Per Square Yard |
|---------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Weed Species | Single Herbicide Study | Herbicide Combination Study | Herbicide Combination Study | Herbicide Combination Study |
| 3,871,866 | 15 | 16 | | |

Table 5

<table>
<thead>
<tr>
<th>Test Composition</th>
<th>Mode of Application</th>
<th>Weed Control, Crop Injury and Soybean Yield as Influenced by Single Herbicide Compositions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate, lb/A</td>
<td>Crop Injury</td>
<td>Yield, bu/A</td>
</tr>
<tr>
<td>Grass</td>
<td>Broad-Leaf</td>
<td>Grass</td>
</tr>
<tr>
<td>2-Chloro-2,6-Diethyl-N-(methoxyethyl)acetanilide, PE</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>4.0</td>
<td>10</td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>4-Chlorophenyl N-methylcarbamate, PE</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>4.0</td>
<td>6</td>
</tr>
<tr>
<td>2-Chloro-2,6-Diethyl-N-(methoxyethyl)acetanilide, PPI</td>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PPI</td>
<td>4.0</td>
<td>3</td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PPI</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>4-Chlorophenyl N-methylcarbamate, PPI</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Isoxpropyl N-(3-Chlorophenyl)carbamate, PPI</td>
<td>4.0</td>
<td>10</td>
</tr>
<tr>
<td>Weed-Free Check</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Weedy Check</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Crop injury values refer to percent stunting.
2Weed Species Present:
°F = Green and Yellow Foxtail (Setaria viridis [L.] Beauv. and Setaria glauca [L.] Beauv.)
°C = Canada Grass (Brachytrum SPP.)
°L = Lambquarters (Chenopodium album L.)
°P = Redroot Pigweed (Amaranthus retroflexus L.)
°R = Common Ragweed (Ambrosia artemisiifolia L.)
°W = Nutsedge (Cyperus esculentus L.)
°M = Eastern Bluegrass (Poa annua L.)
°J = Wild Alumroot (Hypomirs hookeri [L.] Juke)
°G = Canarygrass (Telechala viridula L.)
°S = Pennsylvania Smartweed (Polygonum pensylvanicum L.)
°V = velvetleaf (Abutilon theophrasti Medic.)

Dominant species was Lambquarters with Common Ragweed and Redroot Pigweed next. Nutsedge population was not uniform, thereby precluding a fair rating of this weed.
Table 6

Weed Control, Crop Injury and Soybean Yield as influenced by Herbicide Combinations

<table>
<thead>
<tr>
<th>Test Composition and Mode of Application</th>
<th>Rate, lb/A</th>
<th>Crop Injury</th>
<th>Yield Bu/A</th>
<th>Weed Control at 40 Days&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Weed Escapes&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grass</td>
<td>Broad/Leaf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide, PE</td>
<td>1.5</td>
<td></td>
<td>49.4</td>
<td>96</td>
<td>91</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>1.5</td>
<td></td>
<td>50.0</td>
<td>98</td>
<td>96</td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide, PE</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>2.0</td>
<td></td>
<td>54.3</td>
<td>99</td>
<td>94</td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide, PE</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>2.0</td>
<td></td>
<td>89</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>4-Chlorophenyl N-methylcarbamate, PE</td>
<td>0.375</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>1.5</td>
<td></td>
<td>50.5</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4-Chlorophenyl N-methylcarbamate, PPI</td>
<td>0.375</td>
<td></td>
<td>20.9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weed-free Check</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>Crop injury values refer to percent stunting vs weed-free check.
<sup>2</sup>Herbicide species present same as PN 2, Table 5. Dominant species was Lambsquarters which constituted almost a solid stand in the four-row weed check plots. Other listed species become more common where herbicides controlled Lambsquarters partially or completely. Nutsedge population was not uniform, thereby precluding a valid rating.

EXAMPLE V

A field study of the effect of the pre-emergence application of single herbicides and herbicide combinations was conducted in Decora silt loam having an organic matter content of 2.5 percent. Individual plots were 398 feet long and 12 rows wide with a row spacing of 30 inches. One of the plots was an untreated check. In the late spring, the plots were planted in soybeans (Glycine max L. var. A-100). Two days later, the test compositions were applied. All materials were applied in 15 gallons per acre of water. Intermediate observations were made 35 days after application and are shown in Table 7. Final observations were made at harvest, 125 days after application, and are shown in Table 8. The identity of the test compounds, their rates of application, weed control, crop injury and yields are shown in the tables.

Table 7

Weed Control and Crop Injury As Influenced by Test Compositions Thirty-Five Days After Application

<table>
<thead>
<tr>
<th>Test Composition</th>
<th>Rate, lb/A</th>
<th>Crop Injury&lt;sup&gt;4&lt;/sup&gt;</th>
<th>Weed Control&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Weed Escapes&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grass</td>
<td>Broad/Leaf</td>
<td></td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide</td>
<td>2</td>
<td>0</td>
<td>98</td>
<td>90</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>4</td>
<td>0</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>4</td>
<td>0</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate, PE</td>
<td>1.5</td>
<td>0</td>
<td>95</td>
<td>98</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>1.5</td>
<td>0</td>
<td>95</td>
<td>98</td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide</td>
<td>2</td>
<td>0</td>
<td>CH, GF</td>
<td>95</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate, PE</td>
<td>2</td>
<td>0</td>
<td>CH, GF</td>
<td>95</td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>0.5</td>
<td>0</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Weed-free Control</td>
<td>—</td>
<td>0</td>
<td>95</td>
<td>90</td>
</tr>
</tbody>
</table>

<sup>1</sup>= No injury or control; 100 = complete kill.
<sup>2</sup>Test Abbreviations:
GF = Giant Foxtail (Setaria faberii Herrm.)
LQ = Lambsquarters (Chenopodium album L.)
RW = Ragweed (Eupatorium cannabinum L.)
SW = Smartweed (Polygonum spp.)
MV = Velvetleaf (Abutilon theophrasti Medic.)
MW = Parameil Milkweed (Asclepias spp.)
YN = Yellow Nutsedge (Cyperus esculentus L.)
CH = Carolina Horseweed (Cassia caradicea L.)
HW = Horseweed (Ambrosia trifida L.)
SM = Sunflower (Helianthus spp.)
MG = Morningglory (Ipomoea spp.)

Table 8

Weed Control Any Yield as Influenced by Test Compositions at Harvest One Hundred Twenty-Five Days After Application

<table>
<thead>
<tr>
<th>Test Composition</th>
<th>Rate, lb/A</th>
<th>Yield, Bushels/A</th>
<th>Weed Control&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Weed Escapes&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Grass</td>
<td>Broad/Leaf</td>
<td></td>
</tr>
<tr>
<td>2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)acetanilide</td>
<td>2</td>
<td>45</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>4</td>
<td>42</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Isopropyl N-(3-Chlorophenyl)carbamate</td>
<td>4</td>
<td>41.8</td>
<td>85</td>
<td>85</td>
</tr>
</tbody>
</table>

<sup>1</sup>Test Abbreviations:
FW = Fieldwheat (Aegilops spp.)
MG = Morningglory (Ipomoea spp.)
SM = Sunflower (Helianthus spp.)
3,871,866 19 20 Table 8-Continued Weed Control Any Yield as Influenced by Test Compositions at Harvest One Hundred Twenty-Five Days After Application

<table>
<thead>
<tr>
<th>Test Composition</th>
<th>Rate, Lb/A</th>
<th>Yield, Bushels/A</th>
<th>Weed Control¹</th>
<th>Weed Escapes²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Chlorophenyl N-methylcarbamate</td>
<td>1</td>
<td>40.5</td>
<td>98</td>
<td>90</td>
</tr>
<tr>
<td>2-Chloro-2',6'-diethyl-N-(methoxymethyl)anilide</td>
<td>1.5</td>
<td>98</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>Isoxynyl N-(3-Chlorophenyl)carbamate</td>
<td>1.5</td>
<td>43</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>4-Chlorophenyl N-Methylcarbamate</td>
<td>0.5</td>
<td>0²</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

¹Abbreviations same as Table 7. ²Impossible to harvest because of weeds.

1 claim:

1. A herbicidal composition containing herbicidally-effective amounts of both an alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates and 2-chloro-2',6'-diethyl N-methoxymethylacetanilide and further containing a compound selected from the group consisting of aryl N-alkylcarbamate, aryl N,N-dialkylcarbamate, aryl N-cycloalkylcarbamate, and mixtures thereof in an amount sufficient to extend the soil life of said alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates.

2. A herbicidal composition containing herbicidally-effective amounts of both

   a. an alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates represented by the structural formula

   ![Structural Formula](image)

   wherein $R_1$ is an unsubstituted alkyl or haloalkyl and $X_1, X_2, X_3, X_4$ and $X_5$ are each independently hydrogen or halogen; and

   b. 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide and further containing a compound or mixtures of compounds represented by the structural formula

   ![Structural Formula](image)

   wherein

   - Aryl is phenyl, substituted phenyl, naphthyl, or substituted naphthyl;
   - $R_2$ is hydrogen, unsubstituted alkyl or haloalkyl; and
   - $R_3$ is unsubstituted alkyl, haloalkyl, or cycloalkyl;

   in an amount sufficient to extend the soil life of said alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates.

3. The herbicidal composition of claim 2 wherein

   a. $R_1$ contains from 1 to 8 carbon atoms;
   b. $R_2$ is hydrogen, unsubstituted alkyl containing from 1 to 8 carbon atoms or haloalkyl containing from 1 to 8 carbon atoms; and
   c. $R_3$ is unsubstituted alkyl containing from 1 to 8 carbon atoms, haloalkyl containing from 1 to 8 carbon atoms or cycloalkyl containing from 3 to 8 carbon atoms.

4. The herbicidal composition of claim 3 which contains from about 0.1 to about 100 percent by weight actives.

5. The herbicidal composition of claim 4 wherein

   a. the weight ratio of said alkyl N-phenylcarbamate or mixtures of said alkyl N-phenylcarbamates to said 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide present in the composition is in the range of from 1:500 to 500:1; and

   b. the weight ratio of said alkyl N-phenylcarbamate of mixtures of said alkyl N-phenylcarbamates to said compound or mixtures of said compounds present in the composition is in the range of from 1:1 to 100:1.

6. The herbicidal composition of claim 5 wherein said alkyl N-phenylcarbamate is isopropyl N-phenylcarbamate.

7. The herbicidal composition of claim 6 wherein said compound is selected from the group consisting of halophenyl N-alkylcarbamate, halophenyl N,N-dialkylcarbamate, and halophenyl N-cycloalkylcarbamate.

8. The herbicidal composition of claim 6 wherein said compound is selected from the group consisting of 4-chlorophenyl N-alkylcarbamate, 4-chlorophenyl N,N-dialkylcarbamate, and 4-chlorophenyl N-cycloalkylcarbamate.

9. The herbicidal composition of claim 6 wherein said compound is selected from the group consisting of phenyl N-methylcarbamate, 4-chlorophenyl N-methylcarbamate, 4-chlorophenyl N-ethylcarbamate, 4-chlorophenyl N,N-dimethylcarbamate, 4-chlorophenyl N-butylcarbamate, 4-chlorophenyl N-cyclohexylcarbamate and 1-naphthyl N-methylcarbamate.

10. The herbicidal composition of claim 5 wherein said alkyl N-phenylcarbamate is isopropyl N-(3-chlorophenyl)carbamate.

11. The herbicidal composition of claim 10 wherein said compound is selected from the group consisting of halophenyl N-alkylcarbamate, halophenyl N,N-dialkylcarbamate, and halophenyl N-cycloalkylcarbamate.

12. The herbicidal composition of claim 10 wherein said compound is selected from the group consisting of 4-chlorophenyl N-alkylcarbamate, 4-chlorophenyl N,N-dialkylcarbamate, and 4-chlorophenyl N-cycloalkylcarbamate.

13. The herbicidal composition of claim 10 wherein said compound is selected from the group consisting of phenyl N-methylcarbamate, 4-chlorophenyl N-methylcarbamate, 4-chlorophenyl N-ethylcarbamate, 4-chlorophenyl N,N-dimethylcarbamate, 4-chlorophenyl N-butylcarbamate, 4-chlorophenyl N-cyclohexylcarbamate, and 1-naphthyl N-methylcarbamate.
14. A method of controlling weeds comprising applying to soil containing weeds:
   a. a herbicidal amount of an alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates;
   b. a herbicidal amount of 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide; and
   c. a compound or mixture of compounds selected from the group consisting of aryl N-alkylcarbamate, aryl N,N-dialkylcarbamate, and aryl N-cyclohexylcarbamate in an amount sufficient to extend the soil life of said alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates.

15. The method of claim 14 wherein said alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates is applied at a rate in the range of from 0.1 to 50 pounds per acre, said 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide is applied at a rate in the range of from 0.1 to 50 pounds per acre and the compound or mixture of compounds is applied at a rate which is from 1 to 100 percent of the rate at which the alkyl N-phenylcarbamate is applied.

16. The method of claim 15 wherein the application is a pre-emergence application.

17. The method of claim 15 wherein said alkyl N-phenylcarbamate or mixtures of alkyl N-phenylcarbamates are selected from the group consisting of isopropyl N-phenylcarbamate and isopropyl N-(3-chlorophenyl)carbamate and said compound or mixtures of compounds are selected from the group consisting of phenyl N-methylcarbamate, 4-chlorophenyl N-methylcarbamate, 4-chlorophenyl N-ethylcarbamate, 4-chlorophenyl N-butylcarbamate, 4-chlorophenyl N,N-dimethylcarbamate, 4-chlorophenyl N-cyclohexylcarbamate, and 1-naphthyl N-methylcarbamate.

18. A herbicidal composition containing herbicidal-ly-effective amounts of both isopropyl N-phenylcarbamate and 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide and further containing 4-chlorophenyl N-methylcarbamate in an amount sufficient to extend the soil life of said isopropyl N-phenylcarbamate.

19. A herbicidal composition containing herbicidal-ly-effective amounts of both isopropyl N-(3-chlorophenyl)carbamate and 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide and further containing 4-chlorophenyl N-methylcarbamate in an amount sufficient to extend the soil life of said isopropyl N-(3-chlorophenyl)carbamate.

20. A herbicidal liquid concentrate comprising about 33.5 percent by weight isopropyl N-(3-chlorophenyl) carbamate, about 33.5 percent by weight 2-chloro-2',6'-diethyl N-(methoxymethyl)acetanilide, about 8.3 percent by weight 4-chlorophenyl N-methylcarbamate and about 14.1 percent by weight xylenes.