

THE WEED PROBLEM IN AMERICAN AGRICULTURE.

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THE control of weeds is one of the oldest and still one of the most important problems connected with agriculture. Because we have always had weeds with us, there is a tendency to accept the situation as inevitable and one of the necessary evils connected with farming; consequently no sufficient, general, and concerted effort is being made to overcome the great loss which they cause. Yet the weed fight is one of the standard routine operations on the farm, and it represents a large proportion of the labor necessary to produce crops. No other single feature of farming requires such universal and unceasing attention as do the weeds.

WAYS IN WHICH WEEDS CAUSE INCREASINGLY LARGE LOSSES ANNUALLY.

The annual loss to the farmers caused by weeds is enormous. A discouraging feature regarding this loss is the fact that it grows greater each year.

Weeds are costly and injurious in many ways. They injure crops both in quantity and in quality and greatly increase the labor involved in farming. Other conditions being equal, the yield of most crops is inversely proportional to the growth of weeds. An intertilled crop in which weeds are allowed to grow unmolested is usually an entire failure. Considering the principal crops in the United States, it is estimated that weeds reduce the yield of corn by 10 per cent; tame hay, 3 to 16 per cent; potatoes, 6 to 10 per cent; spring grain, 12 to 15 per cent; winter grain, 5 to 9 per cent; tobacco, fruit, and truck crops, 0 to 5 per cent; pasture, 5 to 50 per cent.

In damage to quality of product due to weeds, the principal sufferers are the small grains, pastures, hay, grass, and seed crops. The annual loss to the spring-grain growers of the Northwest due to dockage of the marketed grain because of weed seeds present amounts to from 3 to 10 per cent of the crop. Winter grain suffers less from weeds than the spring-grain crop.

The extra labor required to keep weeds under control is probably the greatest economic loss which they cause. The labor cost of weeds falls most heavily on the intertilled crops. Numerous experiments have shown that in growing most intertilled crops cultivation is of minor importance except to eliminate weeds.¹ (See Pl. XXXII, fig. 1.) Even in the semi-arid regions, where summer fallow is practiced, presumably to conserve moisture and control weeds, experiments have shown that if weeds be eliminated from the summer fallow, cultivating the land during the summer has little or no effect on the succeeding crop yields. Tillage is by far the most expensive feature of growing intertilled crops (Pl. XXXII, fig. 2). Numerous cost-account records collected by the Office of Farm Management, United States Department of Agriculture, show that on the average diversified American farm the cost of tillage operations comprises from 30 to 40 per cent of the total cost of farm operations. Probably half the total amount of cultivation required is necessary only for controlling weeds, and in many instances practically all intertillage could be eliminated without affecting crop yields if by other means weeds were prevented from growing. Most of the hand labor involved in cultivating intertilled crops other than cotton and truck is necessary only to remove weeds that have been missed by the cultivators.

Such weeds as wild onion,² bitterweed,³ and the ragweeds⁴ cause great annoyance to dairymen and milk dealers. These weeds, when eaten by milch cows, give a very disagreeable odor and flavor to the milk, and consequently to all other dairy products. When cows eat such weeds in large quantities the milk is not marketable. The control of pasture weeds is a big problem for dairymen in certain areas. (See Pl. XXXIII, fig. 1.)

¹ Bureau of Plant Industry Bulletin 257, "The Weed Factor in the Cultivation of Corn," by J. S. Cates and H. R. Cox.

² *Allium* spp.

³ *Helentium tenuifolium*.

⁴ *Ambrosia* spp.

Very often the price of land in a community is largely regulated by the number and character of the weeds present. In many areas of the South Atlantic and Gulf Coast States, where nut-grass¹ abounds, some farms are so badly infested with this weed that their value is reduced almost half, and cases can be cited in which farms have actually been abandoned because of the presence of nut-grass. In some of the areas of the Northern States farms have been abandoned because of quack-grass.

Weeds result not only in big financial loss but also in great annoyance. Diseases such as hay fever could be eliminated almost entirely by adopting efficient methods for controlling the incidental weeds found along roadsides, in vacant fields, and in waste places.

The loss of cattle and sheep due to poisonous weeds is very great. On the United States National Forest ranges alone the loss in 1916 amounted to 6,648 cattle and 16,273 sheep, besides a number of horses, goats, and other animals.

As host plants for many of our worst plant diseases and insect pests, weeds are responsible for an enormous loss. The recent rapid spread of white-pine blister rust, which is threatening several hundred million dollars' worth of the most valuable pine forests, is due entirely to the presence of forest weeds belonging to the genus *Ribes*, which includes wild gooseberries and raspberries. If all the members of the genus *Ribes* were cleared out of the white-pine forests, the disease would disappear automatically. Such insects as the cotton boll weevil and wheat-field chinch bugs usually spend the winters protected by weeds allowed to grow around the borders of the fields.

Many lakes and navigable streams become choked with water weeds; navigation is interfered with and it becomes necessary to cut out the weeds, a difficult task.² Water weeds give trouble in irrigation ditches and canals also. They often make a growth almost sufficient to stop the flow of water. (See Pl. XXXIII, fig. 2.) A conspicuous example is the water hyacinth,³ which presents a serious problem in many of the canals in the Southern States, particularly in

¹ *Cyperus rotundus*.

² The water weed *Elodea canadensis* is likely to prove troublesome in this respect.

³ *Eichhornia crassipes*.

Florida and Louisiana. In maintaining waterways, the cost of keeping weeds under control must be considered.

The esthetic aspect of the weed problem also must be considered. Those farms upon which the "incidental" weeds are kept cut along the fence rows, in vacant fields, and in waste places are much more attractive and salable than farms upon which the weeds are allowed to grow undisturbed. A good lawn free from weeds is a pleasure and a satisfaction worth far more than the effort and expense necessary to maintain it. (See Pl. XXXIV.)

Weeds are injurious and detrimental in so many ways that it is extremely difficult to calculate the damage which they cause. This damage, however, is much greater than is apparent. One big fact regarding weeds is that they increase in numbers each year until their presence is accepted as the normal condition and their detrimental effect overlooked. Insect pests and plant diseases that appear only occasionally command much more attention in proportion to the damage they cause than do weeds, because they are more or less a novelty and farmers are not accustomed to them.

HOW WEEDS REDUCE CROP YIELDS.

Just why weeds reduce crop yields is not exactly clear, but even where plant food, moisture, and light are sufficient for both weeds and the crop, the crop yields generally will be lower than where, under similar conditions, weeds are not present. Experiments have shown that in most cases the total amount of plant food removed by the weeds and a crop grown together is far less than the amount removed by a crop grown alone. For example, if weeds are allowed to grow unmolested in a cornfield, the total amount of plant food removed by the weeds and the corn growing together is far less than the amount removed by a similar field of corn in which the weeds are kept out. Several theories and explanations have been advanced regarding this fact. Root interference is thought by many to be the principal factor involved, and it undoubtedly plays an important part.

HABITS OF WEEDS OFTEN SIMILAR TO THOSE OF THE CROPS THEY INFEST.

Another advantage the weeds have is that of adaptation to crops. Specific weeds are troublesome in fields and crops

in which conditions are most favorable for their development. In other words, the troublesome weeds in a specific crop, such as spring wheat, are those plants whose life history and habit of growth are such that they normally thrive best under the conditions favorable for the production of the crop in question. Two of the most prevalent annual weeds in spring-wheat fields are the wild mustard and the wild oat. These weeds are enabled to exist because they mature seeds which shatter and reinfest the land before the wheat is ready to harvest. A combination of many factors enables weeds to compete successfully with cultivated crops and greatly to reduce the crop yields.

In harmful effect weeds vary extremely. Just as two cultivated crops grown together are not always injurious one to the other, so weeds may not injure the desired crop. Investigations at the Minnesota Agricultural Experiment Station have shown that by growing certain combinations of crops, such as wheat and flax, two-thirds of a normal yield of flax can be produced without reducing the yield of wheat. The presence of other crops, however, as oats in a wheat field, even in small quantities, will reduce the yield of wheat materially. The same variation appears in the effect of weeds in grain fields. Many farmers contend that the presence of wild mustard in a field of rank-growing wheat is beneficial rather than harmful, because it does not reduce the yield of wheat and the stiff mustard stalks act as a support for the wheat, preventing it from falling down and lodging. Other weeds, however, as wild oats and sow thistle, often greatly reduce the yields of wheat. This, again, strongly indicates that the reductions in crop yields due to weeds are not entirely a question of plant food, moisture, and light.

WEEDS BENEFICIAL IN SOME CASES.

Contrary to the usual opinion, weeds are not always harmful; in fact, in some cases they are a great blessing, especially on those farms where proper crop rotations are not practiced and where shiftless methods are employed. (See Pl. XXXV, fig. 1.) Investigations have shown that crop yields in most cases are related directly to the amount of organic matter in the soil. Until efficient cropping systems have been established which include crops that add organic

matter to the soil, this material must be furnished by weeds, farm manures, and crop residues.

On many idle fields the weed growth is sufficient to act as a soil binder and prevent erosion which otherwise would occur, especially in many parts of the South. Probably this is the greatest benefit which weeds confer. Weeds, however, are an advantage only on those farms on which efficient cropping systems and the most effective general farm practices are not followed. As general farm practices and conditions improve, the disadvantages of weeds become greater and more apparent.

CROP ROTATION A FOE TO WEEDS.

The high cost of weeds in many areas is largely the result of single-crop farming. Crop rotation and diversification are the greatest foes of weeds, and usually where a single-crop system of farming is practiced weeds are exceedingly troublesome. In many instances lands have become so foul with weeds that certain crops can no longer be grown profitably upon them. This is true in many of the fields in Louisiana which have been continuously cropped to rice for a number of years, until those weeds which thrive under conditions favorable to the production of rice have become so prevalent that it is no longer profitable to grow the crop.

In California, where wheat has been growing continuously for a number of years, the land has become very foul with weeds. The prevalence of weeds is forcing the introduction of crop rotations and is decreasing the acreage of wheat in that area.

The hard spring-wheat area, composed largely of North Dakota, western and southern Minnesota, and eastern South Dakota, is now going through the same evolution. In this area the grain fields, which have been continuously cropped to wheat for years, have become so badly contaminated with such weeds as wild oats, wild mustard, French weed, and sow thistle that in many instances wheat can no longer be grown profitably. These conditions are being remedied, and the loss due to weeds is being greatly reduced by the adoption of efficient cropping systems and general farm practices, giving due consideration to those methods and practices which are most effective in controlling weeds.

HOW TO CONTROL WEEDS.

To control or eradicate a weed it is first necessary to determine the kind, the character and habits of growth and reproduction, and sufficient about its life history to fix the time when it is most susceptible to treatment.

With regard to methods of control and eradication, weeds may be divided into two classes:

The first class is composed of those weeds which, because of their habits of growth, require special methods or treatments. This class includes such weeds as Canada thistle, quack-grass, hawkweeds, nut-grass, Johnson grass, perennial sow thistle, and many others. These weeds are extremely difficult to kill, and specific methods must be determined for each one, based on a study of the life history and habit of growth.

The second class is composed of annuals, biennials, and such perennials as require no special treatment to kill them. These are often termed incidental weeds. In this case the problem is not one of killing but of controlling.

Comparatively few specific weeds require special methods for their control, and for many of these effective methods have already been determined. After effective methods shall have been evolved for controlling the remaining individual weed problems, such as are presented by nut-grass, sow thistle, hawkweeds, and others, the next step will be to incorporate these special methods into such cropping systems and farm organizations that weeds will be controlled incidentally. Our farm organization should be such that the systems of farming employed and the general farm practices involved will keep weeds under control automatically or incidentally in connection with the regular farm operations. This is true farm economy, because any labor involved in controlling weeds is performed not to create a profit in itself but to avoid a loss.

In addition to finding effective and practicable methods for controlling many of the most pernicious and troublesome weeds, such as quack-grass, Johnson grass, Canada thistle, and others, weed studies have supplied much general information regarding these pests, methods that are effective and practicable in one area may not be applicable

in another area where natural conditions are dissimilar and entirely different systems of farming are practiced. Therefore it is necessary to determine for each area just what methods are most advisable under the existing conditions. Yet some general precautionary measures and practices will be found beneficial and applicable under all conditions. These measures, though well known to most farmers, are not practiced. For instance, most of our small-grain and hay-field weeds have been introduced by sowing impure seeds. Many other weeds are to-day being widely disseminated in the same manner. With the improved cleaning machinery available (see Pl. XXXV, fig. 2) it is usually not difficult to clean seed, yet a large proportion of the seed sown is foul with weed seeds.

In small-grain and hay farming no feature of weed control is more important than the use of clean seed. The cost of cleaning seed is small and the results very marked, yet this fact has not been sufficiently emphasized to impress the farmers with its true importance.

Many weeds are propagated only by seeds. Weed seeds are produced in large numbers along roadsides, fence rows, and ditch banks, in vacant fields, and in waste places, and the seeds are scattered by wind, water, birds, and other agents. By cutting the weeds before the seeds are sufficiently mature to germinate, an enormous amount of trouble and labor and loss could be avoided; but only the most progressive farmers do this. (See Pl. XXXVI, fig. 1.)

A systematic rotation of crops is one of the most feasible and effective means of controlling weeds. Universal crop rotations will not come, however, especially in the small-grain areas, until forced by economic and agronomic conditions, in which weeds will be an important factor. As the lands became foul with weeds, necessitating a rotation of crops, the one-crop system of small-grain farming has gradually been forced farther west. In the westward advance of agriculture, the custom has persisted of growing small grain on the newly developed lands until they become so foul with weeds that crop rotations are necessary. Thus crop rotation is now being introduced in the hard spring-wheat area.



FIG. 1.—CORN FROM CULTIVATED AND NONCULTIVATED PLATS.

Which sheaf is corn that has had no intertillage? One is from an experimental plat at Arlington Farm, Va., which received the usual cultivation, the other from an adjacent plat that was merely scraped with a hoe to keep down the weeds. There was practically no difference in yield.



FIG. 2.—THE PRIMARY OBJECT OF THE INTERTILLAGE OF CORN IS TO CONTROL WEEDS.



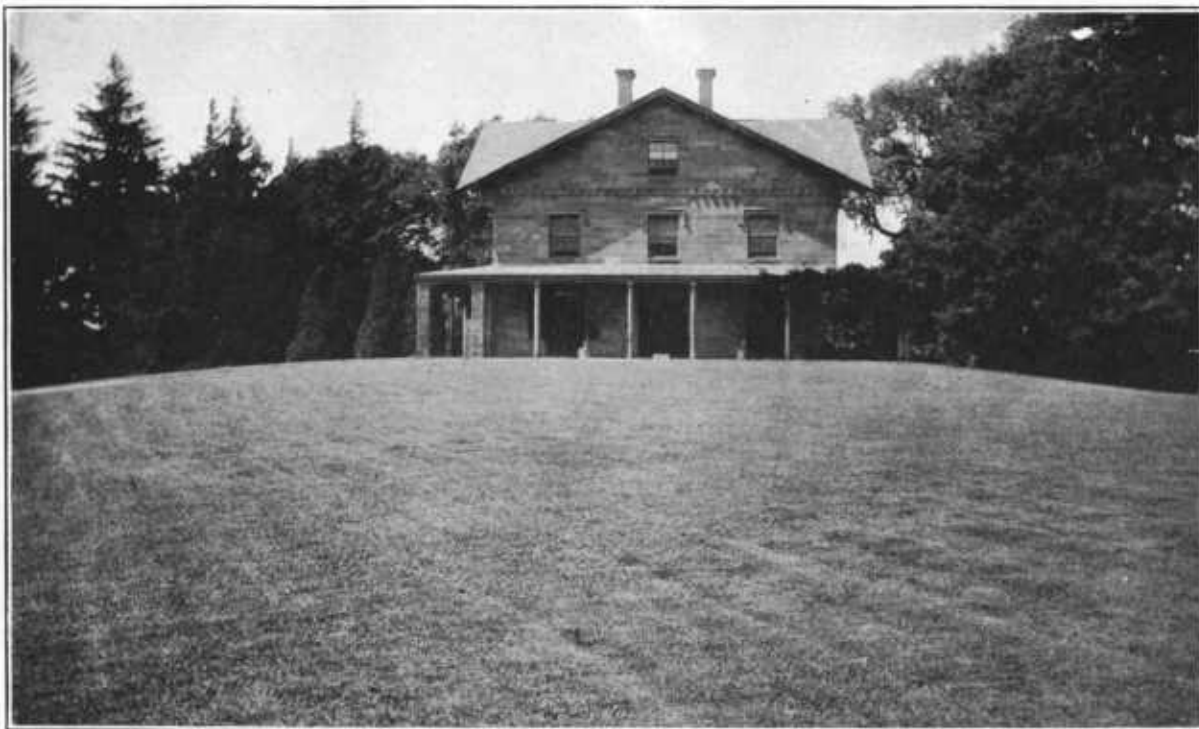
FIG. 1.—A WEEDY PASTURE.

Many pasture weeds can be controlled by mowing before the weed seeds are mature.



FIG. 2.—AN IRRIGATION DITCH WITH WEEDY BANKS.

Weeds are often troublesome in irrigation ditches, and the water is an excellent carrier of weed seeds, transporting them from one farm to another.



A GOOD LAWN, FREE FROM WEEDS; AN ESSENTIAL FOR AN ATTRACTIVE COUNTRY HOME.

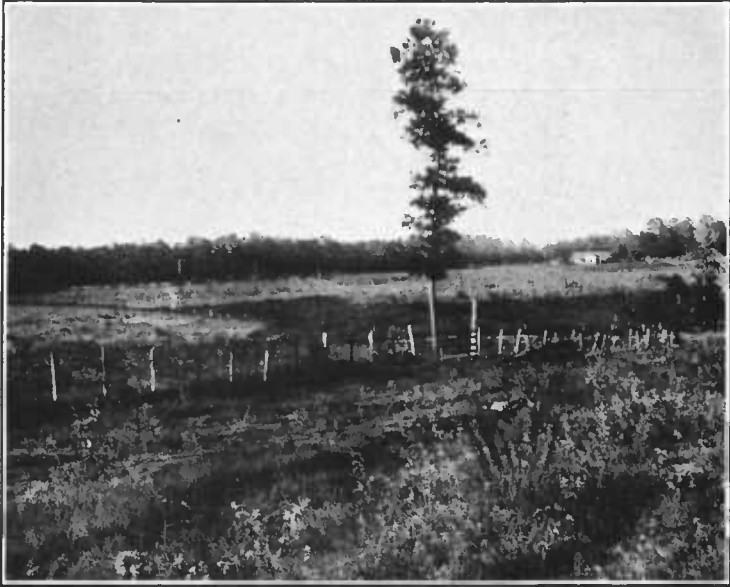


FIG. 1.—A WEEDY VACANT FIELD.

Weeds in vacant fields are often beneficial in adding organic matter to the soil.

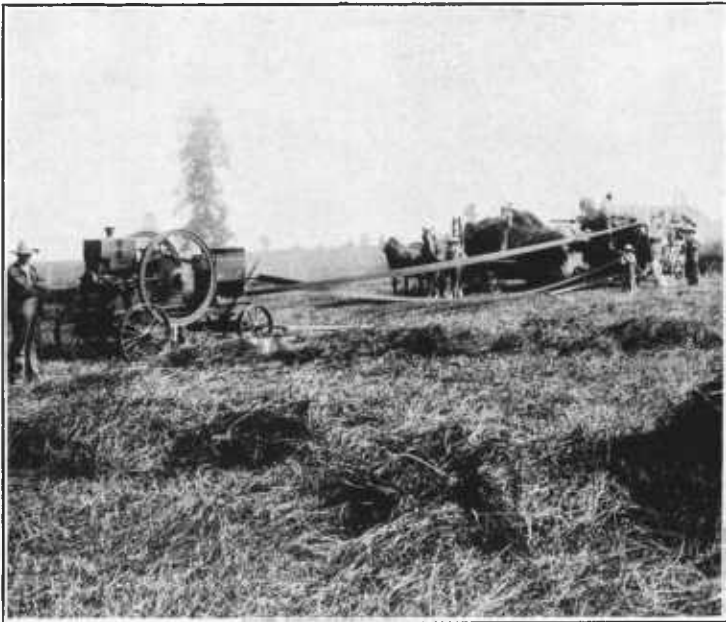


FIG. 2.—THRASHING CLOVER SEED.

Many weeds are introduced by sowing uncleaned seed, because proper cleaning precautions are not taken.



FIG. 1.—A WELL-KEPT ROADSIDE.

Mowing before seed maturity will control many kinds of weeds in fence rows and at roadsides.



FIG. 2.—KILLING WEEDS WITH CHEMICAL PLANT POISONS IN THE ALLEYS OF WASHINGTON, D. C.

The use of chemicals, such as salt, arsenite of soda, nitrate of soda, iron sulphate, copper sulphate, cyanamid, and others, for controlling weeds is not generally advisable. Where it is desired to kill all vegetation, as on tennis courts, walks, and driveways, chemicals can be used to good advantage. (See Pl. XXXVI, fig. 2.) Many of the railroads are now using chemicals for keeping down the vegetation along their rights of way. For general weed control, however, the use of chemicals is a complex process, expensive, and uncertain. In addition, it overlooks a fundamental principle of weed control, namely, that the work should be incidental and in connection with other farm operations in so far as possible.

An important requirement in weed control is to keep on the alert for new weeds which may be introduced and for native weeds which are developing pestiferous tendencies. When any new weed appears it should immediately be called to the attention of some one who can identify it. Many of the worst weeds have been introduced from abroad and have become disseminated through careless and neglectful methods. In fact, comparatively few native plants are troublesome weeds. By immediately reporting the appearance of any new weed which may prove troublesome, measures may be adopted for keeping it under control before it has gained sufficient headway to do serious damage. If the first appearance in this country of weeds such as Russian thistle,¹ field hawkweed,² and Canada thistle³ had been reported to National or State agricultural officers, much of the loss and trouble which they are causing might have been avoided. It is important to report the appearance of new weeds and to take precautions to prevent their dissemination.

Before the most efficient farm organization and cropping system for controlling weeds can be perfected, more definite information regarding weeds and weed-control methods must be obtained. First, it is necessary to determine the weed problem and the individual weeds which are causing trouble in a given region and make a detailed study of these to find when and how the weeds may be destroyed. These investigations should include studies of the biological habits of weeds in somewhat the same manner that the entomologist

¹ *Salsola pestifer*.

² *Hieracium pratense*.

³ *Cirsium arvense*.

and plant pathologist study the life histories and habits of insects and fungi. The object of such studies will be to find the weak point in each weed's career and, having found it, adopt a cropping system and farm practice that will utilize the known weakness. Probably the first important feature of weed control is to know when the individual weeds are most susceptible to injury.

Every locality has individual weed problems peculiar to itself. These problems must be studied in connection with the general tillage systems and other farm operations and practices of the locality. It is just as important to know the general farm practices and customs as it is to know the weeds. One should also know what practices are most injurious to the weeds. In other words, a study of the weed problem not only involves the individual weeds, but includes a study of farm organizations and other general farm practices and conditions.

Not only is it necessary to obtain more definite, clear-cut information about weeds and methods of weed control, but it is just as important to impress farmers with the seriousness of the situation and arouse public sentiment to the support of measures which will lessen the damage caused by weeds.

Practically every State has passed a weed law of some sort, which, if enforced, would do much to relieve the situation. Some of these laws are adequate and practicable; others are absurdly impracticable. In few of the States, however, are these laws enforced. This is because the importance of the weed problem and the loss due to weeds has neither been sufficiently impressed upon the public nor brought to attention in such a manner as to create a public sentiment that will justify enforcing the weed laws. Without the consent and support of the people it is difficult to enforce such laws. Some very effective weed laws are now being enforced in the Canadian Provinces, especially Saskatchewan and Alberta, where a single-crop system of grain farming is practiced. Eventually some weed legislation will probably be enforced throughout the spring-grain areas. Before any adequate weed law can be satisfactorily or advisedly enforced, however, it will be necessary to create a favorable sentiment among the farmers by giving them

more definite information regarding effective and practicable control methods. A national weed law prohibiting the interstate shipment of seed, feed, and other materials that contain viable weed seeds if the contained weed seeds are in violation of the statutes of the State into which they are being shipped would be of great advantage in checking the further distribution of weeds.

Cooperation is one of the first essentials of success in any big commercial enterprise. Cooperation among the farmers is just as essential for controlling weeds. Weed control is a community problem rather than one for the individual farmer to solve, and without community action the efforts of the individual farmer are usually discouraging. This is true because where weeds are allowed to grow undisturbed they produce sufficient seeds each year to infest the adjacent lands. Agricultural clubs and other farm organizations could perhaps undertake no more important cooperative work than that of controlling weeds. The advantages of community action for the control of weeds can not be too strongly emphasized.

