PHYSIOLOGICAL STUDIES ON CERTAIN EGYPTIAN WEEDS

THESIS

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By

ABD EL-MONEIM EL-SAYED SOLIMAN OUDA
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Ain Shams University
Faculty of Science
Botany Department

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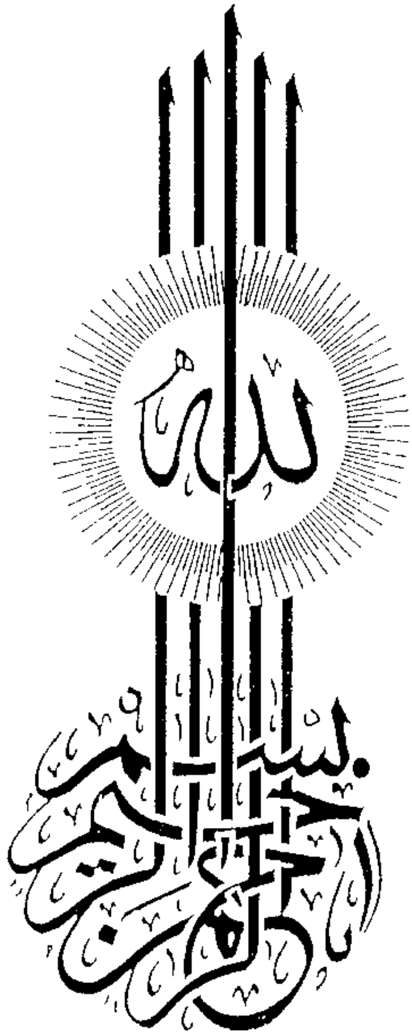
This thesis has not been previously submitted for a degree at this or any other University.

A - Ouda

A. El-M. El-S.S. Ouda.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INTRODUCTION

Man, from the earliest periods of his existence, has contented with certain undesirable species of plants. Such species, unwanted, non useful, often prolific and persistent, interfere with agricultural operations, increase labour, add to costs, and reduce yields. These obnoxious plants are known as weeds. Weeds can be recognized as pests that seriously reduce the productive capacity of agricultural lands and in many other ways interfere with man's efforts to grow useful plants. Weeds cause greater losses than either insects or plant diseases. They are the major barrier to food production and economic development in many regions of the world. Most of the agriculturist's time is spent fighting weeds. Insects and plant diseases may be very serious from time to time but they do not present the eternal problems that weeds do. The prodcution of almost all crops is largely a battle with weeds. The preparation of many products of the soil for human consumption involves the elimination of weeds or their effects.

render a sack of wheat unfit for milling. The bulblets of wild onion (*Allium canadense*) or wild garlic(*Allium vineale*), which are about the size of wheat grain, sometimes occur in the harvested wheat crop, if these contaminate the flour, a garlic flavour is imparted.

3- Weeds reduce the quantity and quality of livestock products. Certain weeds, such as wild garlic, bitterweed (*Helenium tennifolium*), and ragweed, impart an undesirable flavour to the milk from cows that graze upon them. The seeds of certain weeds may become so much entangled in the hair of animals that they reduce the value of the wool or hide.

4- Weeds harbour insect and fungus pests that attack crop plants. Weeds harbour many fungal and bacterial diseases and insect pests. Thus, they aid in propagating crop enemies, which they render more destructive and more difficult to control. The bacterial organism causing bean blight lives on some of the wild legumes; that causing blackleg of cabbage thrives upon wild mustard. Certain wild mustards may harbour the fungus that causes clubroot in cabbage. Downy mildew of lettuce is caused by a fungus that may live on several weeds of the sunflower family (compositae), including prickly lettuce (Lactuca scariola) and common sow thistle (Sonchus oleraceus). Several species of weeds are known to be hosts for one or more virus diseases; aster yellows, for example, is spread by the six-spotted leaf hopper, which is common on several wild hosts, especially the common plantain (Plantago major). Curly top of sugar beets, another virus disease, is carried from wild hosts to cultivated plants by the beet leaf hopper (Eutettix tenellus). The common barberry is an alteranate host for wheat rust. Nematodes and grasshoppers, destructive to many crop plants, live and multiply on weeds; the pink bollworm of cotton is found on wild relatives of this plant, the sweet-potato weevil infests wild morning-glory; the chinch bug overwinters on weeds in waste places; the corn-root aphid lives on a variety of weeds; species of dock (Rumex) are hosts to Citrus thrips, grape leaf hopper, apple leaf hoppers, and other insects; jimson weed (Datura stramonium) is host of red spider, cotton aphid, potato flea beetle and other insects. Though other examples might be cited, those given indicate how weeds aid insect pests. In fact, if weeds could be eliminated, some of our worst crop pests could be easily controlled.

5- Weeds impair human and animal health. Human health is affected by poisonous plants, especially those which cause allergies. Indeed, more than half the world population is affected by plant allergies. Most of these are caused by pollen, but contact with the leaves of poison ivy, poison oak, or poison sumac can cause considerable distress. In tropics, the manchineel tree (Hippomane mancinella) causes severe burns to cattle or humans who rest under it during rains, and it is said to kill anyone who sleeps under it. Also, in tropics it was recorded that workers refuse to enter sugarcane fields infested with pica-pica (Mucuna pruriens). The irritating hairs on this legume fall off on the slightest contact and cause severe inflammation and itching (Velez and Van Overbeek, 1950). Accidental ingestion of poisonous fruits, seeds, berries, or tubers occasionally cause illness and may result to death particularly among children. A number of weeds such as corn cockle (Agrostemma githago), darnel (Lolium temulentum) and certain species of Senecio produces seeds which are poisonous when present in flour and bread. Many people in South Africa have been killed by such poisoning (King, 1966).

Weeds are notorious in that they are species of plants that are particularly successful in invading new areas and in establishing themselves even under adverse conditions. From the principal characteristics that enable certain species to behave as weeds we may mention: the production of numerous seeds, adaptations that provide effective dispersal of seeds, dormancy of seeds, longivity of buried seeds, ability to survive adverse conditions, adaptations that repel grazing animals, and the ability to spread and propagate vegetatively.

The various methods of weed control may be summarized as hand pulling, hand hoeing, tillage, mowing, flooding, heat (fire), smothering with nonliving materials (mulching), cropping and competition methods, biological methods, pasturing and chemical weed control.

We are going to discuss only the chemical method of weed control in some details as it is the main aim of the present work.

Most of the herbicides used in agriculture today have been only developed within the last 15 years(Muzik, 1970). There are at present over 150 herbicides available to the agriculturist (Muzik, 1970). Brian (1964) classified herbicides in two major categories inorganic, and organic herbicides. The inorganic group of herbicides includes ammonium sulphamate, ammonium sulphate, ammonium thiocyanate, calcium cyanamide, cupric sulphate, cupric nitrate, ferrous sulphate, magnesium sulphate/ potassium chloride, potassium cyanate, sodium arsenite, sodium tetraborate, sodium chlorate, sodium chloride, sodium nitrate, and sulphuric acid. The organic group of herbicides is further divided into those containing no nitrogen and those containing nitrogen. The herbicides that contain no nitrogen are the phenoxyacetic acids, phenoxypropionic acids, phenoxybutyric acids, phenylacetic acids, benzoic acids, and halogenated aliphatic acids. The nitrogen containing herbicides are amides, maleic hydrazide, ureas, carbamates, thiocarbamates, triazines, substituted phenols, bipyridylium quaternary salts, toluidines, and miscellaneous nitrogen containing herbicides. From these we shall discuss the urea group of herbicides since the chemical used in the present work is belonging to this group.

By replacing some of the hydrogen of urea (a common fertilizer) with other elements, effective herbicides are produced. No useful fertilizing effects has been reported for these compounds. The four oldest substituted ureas are fenuron, (3-phenyl-1,1-dimethylurea); monuron, 3-(p-chlorophenyl)-1,1 dimethylurea; diuron, 3-(3,4-dichlorophenyl)-1,1-dimethylurea; and neburon,1-n-butyl-3-(3,4-dichlorophenyl)-1-methylurea. Newer substituted ureas, such as norea, cotoran, linuron and siduron, have proven useful in a number of crops.

Muzik (1970) stated that most of the substituted ureas may be used as soil sterilants at high rates and selectively at low rates. Bayer & Yamaguchi (1965), Muzik (1970) and Strang & Gogers (1971) stated that phenylureas are absorbed by the roots and are transported in the xylem in the transpiration stream.

Chemicals which move from the roots upwards in the transpiration stream may severly damage cultivated plants (Aberg, 1964). Levi (1955) showed this damage to be the case for monuron and Wiberg (1959) found that peas, which were sown in the spring of 1952 on lands which had been treated with monuron during the autumn of 1951, had already become chlorotic two weeks after emergence. They never recovered from this damage.

Persistence in soil is largely dependent on the action of micro-organisms although photodecomposition on the soil surface may occur (Jordan *et al.*, 1964;

Comos and Simmons, 1964). Monuron is the most water-soluble and fenuron the least (Klingman, 1963). The substituted ureas are nonvolatile, nontoxic and non-flamable (Muzik, 1970).

Muzik (1970) stated that all the substituted ureas act as inhibitors of photosynthesis. Brian (1964) recorded that one molecule of monuron prevents the photosynthetic activity of over 125 chlorophyll molecules.

Geoghegan (1957) reported that glucose applications caused an increase in the concentration of three phenylurea compounds required to inhibit growth of *Chlorella vulgaris*. Gentner and Hilton (1960) believed that the toxic symptoms produced in barley by the five phenylureas (finuron, monuron, diuron, neburon & DMU) were primarily a consequence of herbicide-induced deficiency of photosynthate.

Minshall (1960) stated that very low doses of monuron (1-2 ug) per gram fresh leaf stimulated dry matter increase. He obtained poisoning of photosynthesis by the use of 5 ug monuron per gram fresh leaf. The same author determined that internal concentrations as low as 15-20 ug monuron per gam fresh leaf inhibited the dry matter increase by 90% in primary leaves of bean. Monuron was particularly effective in suppressing the increase in both water-soluble carbohydrate fraction and starch (Minshall, 1960).

It appears that monuron inhibits the photochemical phase of photosynthesis and in particular that part of the phase involving the photolysis of water (Minshall, 1960). Phenylurea herbicides are known to interfere with light-dependent phases of photosynthesis (Moreland, 1967). Phenylureas were reported to be efficient inhibitors of the Hill reaction in isolated chloroplasts (Wessels and van der Veen, 1956; Cooke, 1956). Moreland and Hill (1962) reported that chlorplasts from plants differing in susceptibility are equally susceptible to Hill reaction inhibition by phenylureas.

Bishop (1958) stated that concentrations of ureas that prevent photosynthesis do not affect the respiration of cells. Geoghegan (1957), however, found that monuron gave marked stimulation of the endogenous respiration of *Chlorella vulgaris*.

Crafts (1961) is no doubt justified in pointing out that the various symptoms observed after treatment with phenylureas indicate a mode of action that goes beyond a cessation of photosynthesis and an attendant starvation.

The chlorotic appearance of seedling plants emerging from monuron-treated soil has given rise to the speculation that this substituted urea in some way interferes with nitrogen metabolism (Freed, 1953). Freed (1953) stated that monuron does in fact affect the N-metabolism, producing a lower percentage of ammonium and nitrate-N and an increased percentage of protein-N. This latter effect is apparently the result of reduced growth. The absorption of nitrate is reduced by 50 % as a result of monuron treatment (Freed, 1953).

A number of other effects have been reported from time to time. For example, Tomizawa (1956) observed increases in the uptake of P^{32} by soybeans after the treatment with phenylureas. Christoph and Fisk (1954) observed a retardation of mitosis in various tissues as a result of substituted urea application.

Attempts to correlate differences in absorption with differential susceptibility have been partially successful. This differential susceptibility may be attributed to adsorption or detoxication or both. The active molecules function in a complex biological system and it may be that not all of them will reach their site of biological action unhindered. Some may interact or efficient than shoots in degrading C^{14}-chloroxuron. The mechanism of these degradations is not known.

Many other investigators (Funderburk et al., 1967; Neptune & Funderburk, 1968; Swanson & Swanson, 1968 and Frear & Swanson, 1971) stated that the relative resistance of some plants to the phenylureas is related to their capacity of degrading these herbicides. However, Strang and Rogers (1971) working with C^{14}-diuron on cotton plants, observed that the radioactivity accumulated in significant concentrations in the lysigenous or pigment glands and the trichomes. The same authors stated that the accumulation of much of the absorbed radioactivity within the lysigenous glands and trichomes should be a major factor in lowering the effective concentration of the herbicide in the leaves of cotton as compared to those of more susceptible species and may thus be a significant factor in the resistance of cotton to the substituted phenylurea herbicides.

Frear, Tanaka and Swanson (1970) stated that the active enzyme N-demethylase and co-enzyme NADPH isolated from microsomes of cell protoplasm were found to act together with oxygen dissolved in plant tissue to detoxify substituted phenylurea herbicides. Out of 14 plant