

19

EFFECT OF SOME HERBICIDES ON THE
GROWTH, CHEMICAL COMPOSITION
AND YIELD OF POTATOES

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By

ALI AHMED FAWZY OMRAN
(B. Sc , M.Sc.)

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APPROVAL SHEET

This Thesis for the Ph.D.
Degree has been Approved by :

Sayed M. Sobhi

M. R. Al-Bayha

M. A. Maw

Committee in Charge

Date : 28 / 6 / 1969.

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C O N T E N T S

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	3
MATERIALS AND METHODS	18
RESULTS	24
I- Weeds	24
A- Growth of weeds	29
1. Effect of nitrogenous fertilizers on the density and dry weight of weeds .	29
2. Effect of MCPA on the density and dry matter content of weeds	29
3. Effect of number of hoeings on the density and the dry weight of weeds .	34
B- Chemical contents of weeds	42
1. Effect of nitrogenous fertilizers on the chemical contents of the weeds .	42
2. Effect of MCPA on the chemical content of the weeds	44
3. Effect of hoeings on the chemical con- tent of the weeds	44
II- Light Intensity Between Potato Plants	58
1. Effect of nitrogenous fertilizers on the light intensity between potato plants .	58
2. Effect of MCPA on the light intensity bet- ween potato plants	62
3. Effect of hoeings on the light intensity between potato plants	62
III- Growth of Potato Plant	67
1. Effect of nitrogenous fertilizers on the number and dry weight of potato leaves .	67

	Page
1. Effect of MCPA on the number and dry weight of potato leaves	71
3. Effect of hoeings on the number and dry weight of potato leaves	74
4. Effect of nitrogenous fertilizers on the number and dry weight of potato stems .	77
5. Effect of MCPA on the number and dry weight of potato stems	80
6. Effect of number of hoeings on the number and dry weight of potato stems	80
7. Effect of nitrogenous fertilizers on the number and dry weight of potato stolons.	83
8. Effect of MCPA on the number and dry weight of potato stolons	87
9. Effect of number of hoeings on the number and dry weight of potato stolons	89
10. Effect of nitrogenous fertilizers on the number and dry weight of potato tubers .	92
11. Effect of MCPA on the number and dry weight of potato tubers	95
12. Effect of number of hoeings on the number and dry weight of potato tubers	97
 IV- Chemical Contents of the Different Organs of Potato Plant	 101
a- Effect of nitrogenous fertilizers on the nitrogen content	101
b- Effect of nitrogenous fertilizers on the phosphorus content	101
c- Effect of nitrogenous fertilizers on the potassium content	106
1. Effect of MCPA on the nitrogen content of the the different parts of the potato plants	109
2. Effect of MCPA on the phosphorus content of the different parts of the potato plant	109

	Page
a. Effect of MCPA on the potassium content of the different parts of the potato plant	112
a. Effect of number of hoeings on the nitrogen content of the different parts of potato plant	115
b. Effect of number of hoeings on the phosphorus content of the different parts of potato plant	118
c. Effect of number of hoeings on the potassium content of the different parts of potato plant	118
Seasonal Changes in the Chemical Contents	123
a. Seasonal changes in nitrogen content	123
b. Seasonal changes in phosphorus "	125
c. Seasonal changes in potassium "	127
V- Potato Yield and Tuber Size	130
1. Effect of nitrogenous fertilizers on the field and tuber size	130
2. Effect of MCPA on the yield and tuber size	133
3. Effect of hoeings on the yield and tuber size	135
GENERAL DISCUSSION	140
SUMMARY	176
REFERENCES	184
ARABIC SUMMARY.	

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I N T R O D U C T I O N

The potato (Solanum tuberosum, L.) is one of the most important vegetable crops in the U.A.R. both for local consumption and export. It ranks second after onion with regard to the tonnage exported to foreign markets and third after onion and tomato with regard to acreage. The area under potato crop increased from 15035 and 17016 faddans in the Summer and the Fall seasons in 1954 to 24896 and 34926 faddans in 1964 respectively.

Weeds are considered as pests that seriously reduce the productivity of agricultural lands since they compete with crop plants for light, water and minerals. Diseases caused by fungi, bacteria and viruses might be hosted by weeds and sooner or later they attack crop plants causing serious losses sometimes. The total annual losses attributed to the weeds exceed those of the other three groups of agricultural pests combined namely.

1) animal diseases, 2) plant diseases and 3) insects. Great number of weeds are widespread in agricultural lands in United Arab Republic. The most important weeds found in field of potato crop are, Nut-grass, Purslane, Hare's lettuce, Wild radish and White goose-foot in Nili crop

and Mallow bindweed, Round's-berry, Mexican goose-foot, Desert figwort and Bermuda grass in Summer crop.

One of the problems of weed control is that weeds need soil conditions similar to that needed for the crop, and consequently competition on mineral nutrients was keen so that it became urgent to get rid of weeds.

The means of weed control differed from hand pulling to hoeing which was replaced by inter-row cultivation. Recently, also, herbicides were used on a large scale.

Since weeds absorb a marked amount of nitrogen from the soil, it is thought that nitrogen application might counterbalance partly the adverse effect of weeds.

The aim of this work is to study the influence of herbicides, hoeing and nitrogen fertilizer on the growth, chemical composition and yield of potatoes. Due consideration was given to the effect of the above factors on the suppression of weeds.

REVIEW OF LITERATURE

I. Growth of the Potato Plant

1. Effect of nitrogen fertilizer :

Nitrogen was postulated by Whitehead et al. (98) to be of primary importance to the potato plant. According to McIntoch et al. (50) the function of nitrogen is to promote the vegetative growth of potato plant. High levels of nitrogen prolonged active growth and delayed senescence and accumulation of dry matter in tubers as shown by (Timmons et al. (93). In United Arab Republic, the amount of nitrogen in the soil is low and consequently potato plants responded favourably to nitrogen fertilizer (Moursi and Makram (55) and El-Baz (17).

Nitrogen affects the yield of potato plant through its influence on the metabolic processes and the growth of the different parts. Moursi and Makram (55) and El-Baz (17) in U.A.R. found that there was an increase in the number of leaves with the increase in the amount of nitrogen fertilizer. In addition, they found an increase in the vegetative growth of the potato plant with increase of the nitrogen fertilizer.

Nitrogen affects the size of potato tubers as was found by, Kruger (42) who reported that increasing nitrogen fertilizer caused an increase in the size of potato tubers.

The dry matter content of the different organs of the plant is also greatly influenced by nitrogen fertilizer. Nitrogen application caused an increase in the dry matter content of the different organs of the potato plant namely leaves, stems, stolons and tubers (Lorenz (45) and (46), Moursi and Makram (55) and El-Baz (17). Terman et al. (89) and Elmer (19) reported that there was a relationship between nitrogen fertilizer and dry matter content of potato tubers.

Nitrogen fertilizer not only affects the dry matter content of potato tubers, but also influences the dry matter percentage. Mothes (53) and Elmer (19) found that nitrogen fertilizer resulted in a depression in dry matter percentage of potato tubers. Terman et al. (90) found that the dry matter content of potato stalks decreased with increasing applications of N, P and K.

Schreven (81) reported that nitrogen deficiency retarded the growth of the potato plants. In addition, Whitehead et al. (98) reported that when in sufficient

nitrogen was available, the plants were more or less stunted and the leaves were small. On the other hand, when nitrogen was added in excess amounts, there was usually a luxuriant growth of very dark green foliage tending to be soft.

The interaction of nitrogen with other minerals as well as with other factors affecting plant growth such as moisture content of soil, and light intensity has a marked effect on growth of potato plants. Moreover, Whitehead et al. (98) concluded that if nitrogen is present in sufficient quantity and with adequate amounts of phosphatic and potassic fertilizers, the haulms were tall and vigorous and this was associated with an increase in the size of leaves and number and size of tubers.

2. Effect of herbicides :

The literature concerning the relationship between herbicides with the growth of the potato crop is scarce and consequently the effect of some herbicides on the growth of the potato crop as well as other crops is reviewed.

There are many herbicides belonging to phenoxy-acetic acid group among which para chlorophenoxyacetic acid (4,CPA), 2,4-dichlorophenoxyacetic acid (2,4-D), tri-

2,4-D, 2,4,5-T, 2,4,6-T, and 2,4,6-Trichloro-4-ethylphenoxyacetic acid (MCPA) are the most important.

Herbicides belonging to phenoxyacetic acid group have a hormonal effect on plants as reported by Muni(59), Crafts (12), Crafts and Reiber (13), Wood et al.(101) and Lucas and Hamner (47). They exert also a detrimental effect on plant tissues through influencing growth. In addition, they have some effect upon the respiration cycle. Based on the facts that they will stimulate respiration, starch hydrolysis, and depletion of food reserves, Van Overbeek (54) has proposed that 2,4-D, might affect oxidative assimilation in the cell by catalyzing transphosphorylation with an attendant energy release.

The effect of these herbicides varies with the concentration as well as with the crop. Rhodes & Tompleman (76) reported that MCPA when used as a selective weed killer on plants at 0.5 ppm. changed root structure and decreased the growth of plant. Robinson (78) concluded that MCPA applied at 2 pt. per acre in two treatments at seven days intervals had no effect on discolouring or checking the growth of Bermuda grass. Dunlop (14) demonstrated that inspite of the damage on cotton field in Texas following dusting of rice field with 2,4-D by airplane, an increase in height of some cotton plant was observed.

Knapp (53) reported that with post emergence treatments applied when peas were 6 - 10 cm. high, 2,4-D and MCPA applications resulted in delayed flowering, reduced pod number per plant and seed number per pod.

Mukhamod Khanov (57) pointed out that treating cotton plants with 2,4,5-T by 0.0, 0.05 and 0.1% solutions during growth up to the formation of the bolls inhibited the growth of the main stem and the formation of leaves.

3- Effect of mechanical means on weed control :

Ploughing, hoeing and inter-row cultivation are the common mechanical means used in controlling weeds in potato field. in general. Hoeing is the most widespread one used in weed control in the potato fields of the U.A.R.

Mechanical method of weed control though checked the weed growth, yet it exerted a harmful effect on the potato root, soil structure and some other phases.

Soil mulch did not benefit the potato crops as shown by Moursi (56) who found that the harmful effect of inter-row tillage in destroying the surface feeding roots exceeded its beneficial effect. This was in case of Kerr's Pink potato variety under narrow inter-row tillage, where not much harm was done to the roots and that there was no difference between this treatment and hand-

weeded treatment. On the other hand, he found that there was no significant difference between inter-row tillage and the uncultivated treatment with regard to the effect on the roots in the case of Red skin variety, where little harm was exerted on the roots because they are less spread in the Red Skin than in the Kerr's Pink. Inter-row tillage has the advantage of killing the weeds and of helping in the formation of dust mulch. Its only disadvantage is its harmful effect on the root system.

Russell and Keen (79) stated that extra cultivation resulted in decreasing yield as it caused damage to the surface feeding roots and to the leaves.

II. Chemical Contents of Potato Plant

1- Effect of nitrogenous fertilizer :

The effect of nitrogen fertilizer on the chemical contents of potato plants is thoroughly investigated. Nitrogen fertilizer increased the nitrogen contents of plants and tubers of potato as shown by (Lorenz, 45) and (Terman et al., 90) and increased percentage and absolute amount of nitrogen in the different organs of potato plant namely leaves, stems, tubers and stolons as reported by Moursi and Makram (55) and El-Baz (17).