EFFECT OF SOME GROWTH REGULATORS ON GROWTH AND YIELD OF POTATO PLANT

By

SAMIR OSMAN MOHAMED EL-ABD

B. Sc. in Agriculture (Ain Shams University). 1972

Thesis

Submitted in Partial Fulfilment of
the Requirements for the Degree of

MASTER OF SCIENCE

in

Vegetable Crops

From

Horticulture Department
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بسم الله الرحمن الرحيم

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

INTRODUCTION

Potato plant, Solanum tuberosum L., is one of the most important vegetable crops grown Egypt. It is the third export crop, preceded only by cotton and rice. The total area cultivated increased from 55299 feddans in 1960 to 77225 in 1968 and reached 152279 in 1977. The corresponding production of potato was 373784 tons in 1960, 472080 tons in 1968 and 1010366 tons in 1977.

The yield potential of any variety, apart from being varietal in character, is influenced to a great extent by the environmental factors. It is now well known that in potatoes tuber yield is directly related to the area and the longevity of leaves present during the tuber growth, and the environmental factors which stimulate haulm growth delay the tuber initiation. Thus, the form and the functions of the aerial parts in potato play a pivotal role in tuber production. It seems general that the formation of storage organs is associated with the suppression of elongation growth (Burton 1966; Milthorpe and Moorby , 1966.

As outcome of recent studies on the growth processes in potatoes and the role of growth regulators in these precesses it has become possible to increase the yield by manipulating the growth characters and by altering the distribution of dry matter in different plant parts responsible for higher yield.

This work aimed to maximize the yield of potato plants by using different concentrations of gibberellin, cycocyl and pyrogallic acid and to inivestigate the effect of these growth regulators on the growth of potato plants during development under the Egyptian conditions.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

I- Introductory

The fruit is not the only organ with mobilization properties so strong that it swells into an inflated storage structure. The swellings of stems into tubers appear to be different morphological manifestations of the same ontogenetic end. In each case a powerful set of mobilization activities builds up large stored supplies of carbohydrates, and the location of this mobilized depot is an organ in which the polarity has been degraded.

The formation of tubers has several interesting analogies to the flower and fruiting activities of plants. In addition to the powerful mobilization actions which are shared with numerous fruits, tubers may be formed in response to an induction phenomenon which occurs in the leaves and is transmitted to the part which will do the swelling. There follows a morphological differentiation and then growth of the storage organ, and to continue the analogy, the tubers, like some fruits, than experience a ripening phenomenon.

How the swelling organ develops is not well understood. In the potato tuber, the first morphological beginning is the lateral enlargement of cortical cells immediately behind the tip of a stolon; lateral enlargement is then extended through the mitotic activity of cortical cells, and the mitotic activity continues throughout the progress of tuber growth. The internodes and nodes of the stolon are retained during the tuber development.

The formation of tubers normally occurs at the tips of ageotropic stems or stolons, the lack of polar elongation being there associated with recumbent stem growth. The tuber retains the nodes as "eyes", with a leaf bract or scar and subtended bud; the expression of apical dominance by the terminal eye over the other eyes of the tuber is a natural carryover from the stem situation.

In recent experiments of Kumar and Wareing (1972) with potato (Solanum andigera) it was determined that apical dominance controlled the development of the basal axillary shoots as stolons. Stolons normaly developed only from axillary buds located below the soil surface, and darkness and a moist atmosphere were found to favour stolon emergence. Manitaining the axillary buds of aerial shoots under conditions of darkness and humidity caused them to emerge as stolons and all axillary buds subjected to apical dominance were potentially capable of emerging as stolons. In rooted stem cuttings basal axillary buds not subjected to apical dominance grow as leafy shoots, but when the roots were removed they developed as stolons.

Tuber formation is associated with a suppression of normal elongation growth. During tuber formation, there is an inhibition of the nodes in which the tuber formation will occur (Esashi, 1960) and also a systemic inhibition of vegetative growth (Werner, 1947). The time of tuber development is associated with a retarded growth of above ground parts,(Wassink and Stolowijk, 1953), followed generally by a senescence of aerial parts at the time of completion of tuber growth.

The progress curves for tuber growth show an exponential character, (Plaisted, 1957). Thus, the great bulk of the tuber-filling activity occurs very near the end of the growth season. In potato, the tuber growth by roughly equal activities of cell division and enlargement.

An interesting aspect of tuber growth is the facility with which materials can be moved form one developing tuber to another. The number of developing tubers can actually decrease during the growing season (cf. Hardenburg, 1949), and the entire contents of some tubers can be transferred into others. Also, it is not uncommon for potato vines to commence regrowth late in the season after a killing frost for instance, and this regrowth is at the expense of the tuber crop.

The formation of tubers appears to be another dramatic expression of mobilization phenomena in plants. Again we are confronted with the abyss of ignorance concerning how these mobilization events can transpire.

II- Effect of light

a) Effect on growth :

Several reports noted that long-day, 17 - 21 hr., favoured vegetative growth than short-days; 10 - 12 hr.

(Werner, 1934; Wassink and Stolwijk, 1953; Bodlaender, 1958; Krug 1960; Alvey, 1963; Caeser and Krug, 1965; Krug, 1965). Plants grown under long-day conditions were taller, heavier and produced more leaves than plants grown under short-day conditions (Wassink and Stolwijk, 1953; Bodlaender, 1958; Alvey, 1963, 1965; Digby and Dyson, 1973).

Short-days 12-hr . retarded the rat of internode production of potato. In 18 hr . or 24 hr . photoperiods internode length increased from base to apex but in 12-hr photoperiod this graduation was not apparent (Digby and Dyson, 1973).

Vegetative growth was also promoted by high radiation (Milthorpe, 1963). Plants grown at high light intensities were capable of higher photosynthetic activity than similar plants grown at low light intensities (Leopold, 1964; Meyer et al. 1965). The critical light intensity required for haulm growth was in the range of 4 - 100 Lux. (Krug, 1960). Increasing light intensity increased the number of leaves (Alvey, 1963) as well as leaf area per plant (Bodlaender, 1958). However, stem elongation was more pronounced at lower than at higher light intensities (Bodlaender, 1958; Milthorpe, 1963).