Pak.J.Bot., 27(2): 271-274, 1995.

INFLUENCE OF SILVER NITRATE AND GIBBERELLIC ACID ON THE TRANSPORT OF ^{14}C-INDOLEACETIC ACID IN *ZEA MAYS* L.

S.S.M. NAQVI, SABA MUMTAZ, AISHA SHEREEN AND M.A. KHAN

Plant Physiology Division,
Atomic Energy Agricultural Research Centre,
Tando Jam-70060, Pakistan.

Abstract

The effect of silver nitrate and gibberellic acid on ^{14}C-IAA transport parameters was investigated in coleoptile segments of *Zea mays* L. Silver nitrate and GA_3 enhanced the transport intensity and density without affecting absorption and the velocity. The data has been interpreted to show that these chemicals may influence abscission by increasing the relative hormone concentration at the abscission zone.

Introduction

Studies on the mechanism of hormonal control of abscission indicate that the quantity of auxin reaching the abscission zone from distal end plays an important role in preventing premature shedding of plant organs (Osborne, 1974; Woolhouse, 1978; Sexton, 1995). The factors which can influence auxin transport from the distal source should therefore, affect the process of abscission. There are reports where ageing, abscisic acid and ethylene reduce (Pilet, 1971; Beyer & Morgan, 1971; Naqvi & Engvild, 1974; Riov & Goren, 1979; Jacobs, 1979; Naqvi, 1995) while auxins and gibberellic acid enhance auxin transport (Hertel & Flory, 1968; Pilet, 1965; Naqvi, 1995; Sexton, 1995) and delays premature shedding in a number of plants. Silver ion also reduce premature shedding in many plants by antagonizing ethylene action (Beyer, 1976, 1979; Naqvi *et al.*, 1990; Naqvi, 1995) but its effect on auxin transport is not known. Experiments were therefore conducted to study the effect of silver nitrate and gibberellic acid on ^{14}C-indoleacetic acid (^{14}C-IAA) transport in order to determine their role in the hormonal control of abscission.

Material and Methods

Healthy kernels of *Zea mays* L., (cv. Akbar) after soaking in water for 4 hr were placed on cotton wool saturated with distilled water in plastic bread boxes. The boxes were covered and placed in an incubator at $30 \pm 1^{\circ}C$. Between 48 and 54 h the germinating kernels were exposed to red light (white fluorescent tube wrapped in six layers of red cellophane) to suppress mesocotyl growth. Otherwise, they were maintained in darkness till the seedlings were used for transport determinations of ^{14}C-IAA (96 h after planting).

Indol-3yl-acetic acid-2-^{14}C (sp. act. 2 GBq/mM; Amersham) at a concentration of $2.28x10^{-6}$M(0.4 mg/l) was incorporated in 1.5% agar donor blocks (Difco-Bacto). Gibberellic acid (GA_3, $1.44x10^{-7}$M) and silver nitrate ($1.18x10^{-6}$M) were also incorporated in the donor blocks whenever necessary. The receiver blocks consisted of 1.5% plain agar.

Coleoptiles of 30-35 mm length were selected and commencing 1-2 mm below the tip the contiguous 10.0 mm segments were excised and the leaf was pushed out. Each segment was then placed on a 1.5% receiver block in normal vertical orientation and the apical cut end was covered with an appropriate donor block. Each assembly thus consisted of one coleoptile segment with its donor and receiver blocks. These assemblies were kept in Petri-dishes under water saturated atmosphere. Seedling manipulations and the transport determinations were carried out at room temperature ($28\pm2^{\circ}C$) under green light (green fluorescent tube wrapped in six layers of green and amber cellophane). At the end of each 0.5 h up to 2.0 h four assemblies were pooled and donors along with 2 mm basal tissues were placed in three separate vials containing 10 ml of Naqvi's scintillant (Naqvi, 1971). The vials were placed in a refrigerator overnight for extraction. The radioactivity in the vials were assayed in a Packard liquid scintillation spectrometer (Model TRI-CARB 1500). After background correction, net activities and the data derived from them were evaluated by analysis of variance. The experiments were replicated three times.

Results and Discussion

Gibberellic acid and silver nitrate did not affect ^{14}C-IAA absorption but they did enhance the transport out of the segments (Table 1). Analysis of the time course data (Fig.1) shows that the time-axis intercepts of the linear accumulation of radioactivity in the receiving system are 0.43 (control), 0.41 (GA_3), and 0.44 ($AgNO_3$). Since the final tissue length was 8.0 mm the velocity of auxin movement was 18.60, 19.51 and 18.18 mm/h. Similarly the slope of the line, representing transport intensity was 834, 1296 and 1049 cpm/h, respectively. The results indicate that GA_3 and $AgNO_3$ enhances auxin transport intensity and the density without having any effect on its velocity.

Kuraishi & Muir (1962) have shown that treatments with GA_3 causes significant increase in the recovery of diffusible auxin from stem apices of pea and sunflower,

Table 1. Percent distribution of radioactivity 2.0 h after apical application of ^{14}C-IAA.

Treatment	% of applied		% of absorbed	
	Donor	Absorbed	Tissue	Receiver
Control	61.20	38.80	76.84	23.16^{b}
GA_3	58.83	41.17	67.37	32.63^{a}
$AgNO_3$	61.57	38.43	72.08	27.92^{c}

Paired means with unlike postscript differ significantly at chance probability of 0.01.

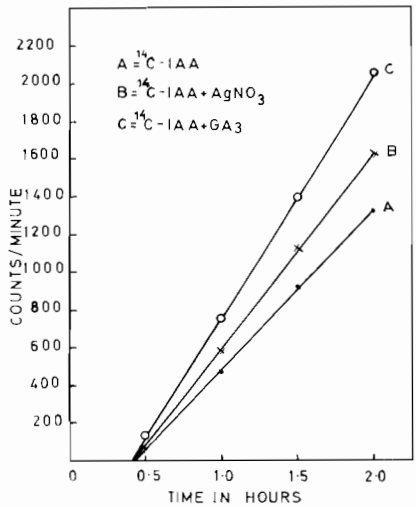

Fig.1. Effect of gibberellic acid and silver nitrate on ^{14}C-indoleacetic acid transport through *Zea mays* L., coleoptile segments.

corresponding with the increased growth of the plants. Shastry & Muir (1963) also observed an increase in the amount of diffusible auxin obtained from tomato flowers at anthesis, which is otherwise not detectable by *Avena* bioassay, when treated with GA_3. It was suggested that GA_3 enhanced the formation of the auxin. However, the possibility that this enhancement may have been due to an increase in the transport of the endogenous auxin, because the collection of diffusible auxin requires transport, was not investigated.

Examining the relationship between IAA and GA_3, on apical dominance in pea, Jacobs & Case (1965) found an increase in the basal accumulation of ^{14}C-IAA when both the hormones were simultaneously applied. It was suggested that an increased accumulation was on the basis of auxin-sparing action of GA_3 rather than its effect on transport. A critical analysis of the methods used (Kuraishi & Muir, 1962; Shastry & Muir, 1963; Jacobs & Case, 1965) indicates that before drawing the conclusions they did not attempt to experimentally eliminate the possibility of GA_3 effect on auxin transport parameters.

Pilet (1965) studied the effect of GA_3 on ^{14}C-IAA transport in *Lens culinaris* stem segments and concluded that the treatment increased the absorption as well as the transport velocity of the applied auxin. An examination of his data however indicates that the velocity of the controls may not have been different but the slope of the lines (transport intensity) was definitely not identical. Therefore, under the conditions where the transport parameters significantly varied within the control it is difficult to draw any valid conclusion.

There does not appear to be any report where the effect of $AgNO_3$ on auxin transport kinetics have been studied. Our studies show that the chemical enhances transport intensity without materially affecting other parameters.

Auxin transport capacity (intensity) declines and ethylene synthesis rises before natural abscission occurs (Beyer & Morgan, 1971) and exogenous auxin prevents the

effect of exogenous ethylene on auxin transport (Beyer, 1976; Riov & Goren, 1979). Presumably, reduction of auxin transport as well as auxin supply are involved in the process of abscission. It is known that auxin and GA_3 enhances auxin transport (Hertel & Flory, 1968; Pilet, 1965) and our data also shows that $AgNO_3$ and GA_3 also acts similarly. The relative hormone levels in various parts of the plant can determine whether or not that part will become senescent. It is therefore reasonable to suggest that $AgNO_3$ or GA_3 delays abscission by enhancing auxin transport intensity which increases the relative hormone levels at the abscission zone.

Acknowledgement

We are thankful to Mr. Zahid Pervez for typing the manuscript.

References

Beyer, E.M., Jr. 1976. Silver ion: A potent antiethylene agent in cucumber and tomato. *Hortscience*, 11: 195-196.

Beyer, E.M. Jr. 1979. (^{14}C) Ethylene metabolism during leaf abscission in cotton. *Plant Physiol.*, 64: 971-974.

Beyer, E.M. Jr., and P.W. Morgan. 1971. Abscission. The role of ethylene modification of auxin transport. *Plant Physiol.*, 48: 208-212.

Hertel, R. and R. Flory. 1968. Auxin movement in corn coleoptiles. *Planta*, 82: 123-144.

Jacobs, W.P. 1979. *Plant Hormones and Plant Development*. Cambridge University Press, Cambridge, UK.

Jacobs, W.P. and D.B. Case. 1965. Auxin transport, gibberellin and apical dominance. *Science*, 148: 1729-1731.

Kuraishi, S. and R.M. Muir. 1962. Increase in diffusible auxin after treatment with gibberellin. *Science*, 137: 760-761.

Naqvi, S.M. 1971. Comparison of scintillants for determination of radioactivity in agar gel by liquid scintillation counting. *The Nucleus* (Pakistan), 8: 109-112.

Naqvi, S.S.M. 1995. Plant growth hormones: Growth promotors and inhibitors. pp. 527-556. In: *Handbook of Plant and Crop Physiology*. (Ed.) M. Pessarakli, Marcel Dekker, Inc., New York. USA.

Naqvi, S.M. and K.V. Engvild. 1974. Action of abscisic acid on auxin transport and its relation to phototropism. *Physiol. Plant.*, 30: 283-287.

Naqvi, S.S.M. S.M. Alam and Saba Mumtaz. 1990. Effect of cobalt and silver ions and naphthalene acetic acid on fruit retention in mango (*Mangifera indica* L.). *Aust. J. Exptl. Agric.*, 30: 433-435.

Osborne, D.J. 1974. Internal factors regulating abscission. In: *Shedding of Plant Parts*. (Ed.) T.K. Kozlowski. Academic Press, London.

Pilet, P.E. 1965. Action of gibberellic acid on auxin transport. *Nature*, 208; 1344-1345.

Pilet, P.E. 1971. Abscisic acid action on basipetal auxin transport. *Physiol Plant.*, 25: 28-31.

Riov, J., and R. Goren. 1979. Effect of ethylene on auxin transport and metabolism in midrib sections in relation to leaf abscission of woody plants. *Plant Cell Environ.*, 2: 83-89.

Sexton, R. 1995. Abscission. pp. 497-526. In: *Handbook of Plant and Crop Physiology*. (Ed.) M. Pessarakli, Marcel Dekker, Inc., New York, USA.

Shastry, K.K.S. and R.M. Muir. 1963. Gibberellin: Effect on diffusible auxin in fruit development. *Science*, 140: 494-495.

Woolhouse, H.W. 1978. Senescence process in the life cycle of flowering plants. *Bioscience*, 28: 25-31.

(Received for Publication 16 August, 1995)