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AUXIN EFFECTS ON ROOT AND SHOOT INITIATION AND THE SUBSEQUENT GROWTH OF WHEAT PLANTS.

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Effects of external IAA and IBA feeding to the germinating seeds of wheat Mexi-Pak were studied on the root and shoot initintion and the subsequent plant growth. Seeds germinating on auxin substrate showed significant supression of the initiation and the elongation of the primary roots and shoots of the seedlings. However, when the external auxin feeding was stopped and the seedlings were grown under natural environments the IAA inhibited seedlings exhibited remarkable recovery in their subsequent root and shoot development and gave higher grain yield per plant. No such recovery and accelerated plant growth were observed in the IBA inhibited seedlings, suggesting stronger inhibitory IBA effects.

INTRODUCTION

There is mounting evidence of increasing crop yields by treating seeds with auxins before sowing Cholodny (1936) obtained an increase in the total crop yield up to 55 per cent in oats. Thimann and lane (1938) observed 50 per cent increase in the total dry weight of wheat as a result of auxin treatment. Similarly, Bouillenne- Walrand (1946) reported an increased yield of 40 per cent in maize Audus (1963) reported significant responses when auxin strength ranged between 24 to 100 ppm.

It is extremely improbable that auxin treatment of seeds may cause auxin augmentation of mature plants and thereby bring about increased crop yields. Any effects on yield would, therefore, be indirect ones; and there is experimental evidence suggesting that they might be caused by an early direct stimulation of root growth (Lane, 1936; Friedrich, 1946; Audus, 1963; Morre and Bonner, 1965). If this early advantage were maintained during the later growth stages, increased yield might easily result from increased water and mineral nutrients absorption, The present investigations were undertaken to study the effects of treating wheat seeds with different concentrations of auxins on the root initiation and subsequent plant growth of wheat plants.

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MATERIALS AND METHODS

The seeds of wheat variety Mexi-Pak were grown on a series of slanted substrate devices containing 25, 50 and 100 ppm of IAA and IBA solutions which were continuously fed to the germinating seeds. In the case of check, distilled water was used as a substrate. When the seedlings attained one leaf stage, root initiation, primary root and shoot growth were measured before transplanting them in 13.5cm pots filled with 2 lb. well mixed sandy loam soil. Each pot contained one seedling fertilized at the rate of 100 lb. N per 2 x 10^6lb. soil. Eight seedlings per treatment were arranged in a completely randomized design and grown to maturity. The pots were watered uniformly when necessary to prevent the moisture stress of the plants during growth. At maturity, each plant was washed with water, draining the whole soil gradually to recover all the roots of the plants from the pots. The plants were then dried at 70°·C for 72 hours and the total plant and root dry weights were taken. The shoot weight of each plant was calculated by substracting the root weight from its total plant weight. Standard procedures were used to record spike length, number of kernels per spike and the grain yield per plant. Duncan's multiple range test was employed to measure the significance of the treatment means.

RESULTS AND DISCUSSION

Germinating wheat seeds on auxin substrate till the one-leaf stage significantly suppressed the initiation and the elongation of the primary roots and shoots of the seedlings as compared to those of the untreated ones. (Plates 1, 2 and Table 1). However, when the IAA inhibited seedlings were transplanted in the pots and grown under natural environments they showed remarkable recovery (Plate 3) and acceleration in their subsequent root and shoot growth as was evident from the total root and shoot dry weights of the plants taken at maturity (Table 2). No such recovery was shown by the IBA inhibited seedlings (Plate 3 and Table 2).

As a result of IAA stimulated growth, the plants also developed longer spikes with greater grain number per spike and consequently yietded more (Table 2). 50 ppm appeared to be the optimum dose.

The suppressed initial growth of the seedlings may be attributable to the inhibitory effects of IAA concentration built up within the root and shoot regions of the germinating embryo as a result of its continous feeding

on external IAA solutions, This view is supported by the works of Lane (1936), Thimann (1937) and Skoog (1938), which showed evidence of translocation and accumulation of IAA in the shoot as a result of continuous feeding of root in external auxin medium, They have observed inhibitory effect on growth due to higher IAA concentrations.

TABLE 1 *Effect of germinating wheat seed on auxin substrate on the root initiation, primary root and shoot length at the one-leaf stage*

	IAA			IBA		
ppm	(1) Av, Root No,/Seedling	Av, Root Length (cm)	Av, Shoot Length (cm)	Av, Root No, per seedling	Av, Root Length (cm)	Av, Shoot Length (cm)
0	4.75 a (2)	7..00 a	3.61 a	4.75	7.00	3.61 a
25	0.78 b	0..22 b	2.61 c	—	—	2.60 b
50	0.25 b	0..25 b	1.47 c	1.12	1.06	1.70 b
100	0.37 b	0..23 b	1.60 c	—	—	1.10 b

(1) Av, of eight seedlings,

(2) Duncan's multiple range test at the 5 per cent level. Any two means within a column not sharing a letter differ significantly.

TABLE 2. *Effect on the root and shoot dry weight and the grain yield per plant at maturity, after the external auxin feeding was stopped at the one-leaf stage of the plants*

	IAA			IBA		
ppm	(1) Av, Root wt, (gm)	Av, Shoot wt, (gm)	Av, grain yield (gm)	Av, Root wt, (gm)	Av, Shoot wt, (gm)	Av, grain wt. (gm)
0	0.23 e (2)	41.37 c	0.50 c	0.23	48.27	0.50
25	0.59 b	51.50 abc	0.60 bc	0.10	43.50	0.31
50	0.91 a	57.00 a	1.01 a	0.14	47.50	0.36
100	0.81 ab	54.15 a	0.85 ab	0.16	46.80	0.33
				N.S(3)	N.S	N.S

(1) Av, of eight plants

(2) Duncan's multiple range test at the 5 per cent probability level. Any two means within a column not sharing a letter differ significantly,

(3) Not significant at the 5 per cent level.

However, this higher IAA built up within the growing tissue of the seedling was possibly responsible for the stimulated later growth, when externel auxin feeding was stopped and they were grown in pots under natural environments. Such rapid resumption of growth when the auxin-inhibited seedlings are removed from the auxin medium was also observed by Thimann and Lane (1938), Pilet and Kober (1958), Andreae (1964) and Hejnowiez and Erickson (1968). This accelerated growth is considered to be an after-effect of the action of IAA on the root system. The increased root growth probably affected the shoot growth favourably. Such inter-relation between root and shoot growth has been discussed by Audus (1963).

Plate 1. Seeds germinated on distilled water at the one-leaf stage.

Plate 2. Seeds germinated on the auxin substrate at the one-leaf stage.

Plate 3. (Left) control seedling. (Centre) Accelerated growth of IAA inhibited seedling after external IAA feeding was stopped. (Right). No such recovery in growth was shown by the IBA inhibited seedling.

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