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Short Communication

PSEUDOGIBBERELLIN A_1 AS AN INHIBITOR OF THE GA_3-INDUCED GROWTH OF RICE SEEDLINGS

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Summary. Pseudogibberellin A_1 inhibited the GA_3-induced growth of rice seedlings; this inhibition was completely overcome by increasing the concentration of GA_3. It is concluded that pseudogibberellin A_1 may act as an antigibberellin.

It is presumed that the primary action of a growth substance is initiated by the combination of that substance with an acceptor in the cell. Thus, a growth promoting substance like substrates in enzyme-substrates combinations must meet specific structural requirements depending on the acceptors present in the cell. Compounds lacking structural requirements for biological activity may however have structural properties similar to a growth promoting substance and thus be able to compete for the acceptor acting as an inhibitor of growth. Such competitive inhibitors are of common occurrence in enzymatic studies.

MCRAE and BONNER [*7*] showed that compounds which closely resemble auxins in structure but which lack some of the requirements for auxin activity were competitive inhibitors of auxin-induced growth. They regarded antiauxins as compounds that specifically interfere with the molecular function of auxin.

Evidence that certain naturally occurring substances act as inhibitors of gibberellin-induced growth has been reported [*1*, *5*]. KÖHLER [*5*] found a substance from *Vicia faba* which acts as an competitive inhibitor of gibberellin-induced growth. However, the chemical nature of the substance has not yet been elucidated.

The structural requirements for gibberellin activity are as yet not understood. Biological activity is variable and depends on the materials to be tested as well as the structure of the gibberellin molecule. Pseudogibberellin A_1 ($PSGA_1$) has been shown to be inactive in the rice seedling assay [*9*], although it is identical to GA_1 except for the α-oriented hydroxyl group on the A ring as compared to the β-oriented hydroxyl group of GA_1. We reasoned that $PSGA_1$ may have inhibitory properties in the gibberellin-induced growth of rice seedlings and possibly act as an antigibberellin. We tested this compound for its effect on gibberellin-induced growth in rice seedlings. $PSGA_1$ was synthesized from GA_1 by Prof. TAKAHASHI, Tokyo University. Because of its availability GA_3 was used as the active gibberellin (GA_3 differs from GA_1 in the presence of a double bond in the A ring). The rice seedling assay (cv. NORIKURA) was used as described by KATO et al. [2].

The results are illustrated in Fig. 1. At lower concentrations of GA_3 $PSGA_1$ inhibited GA_3-induced elongation; this suppression was completely overcome by increasing concentration of GA_3. The pattern of the interaction curves is very similar to those of auxin-antiauxin interaction curves [8] and gibberellin-antigibberellin interaction curves [6]. Thus, $PSGA_1$ may act as a competitive inhibitor of GA_3-induced growth of rice seedlings.

$PSGA_1$ was also tested for its biological properties in the elongation of cucumber hypocotyls and the elongation of maize leaf sheaths. The assay methods followed the description by KATSUMI et al. [3, 4].

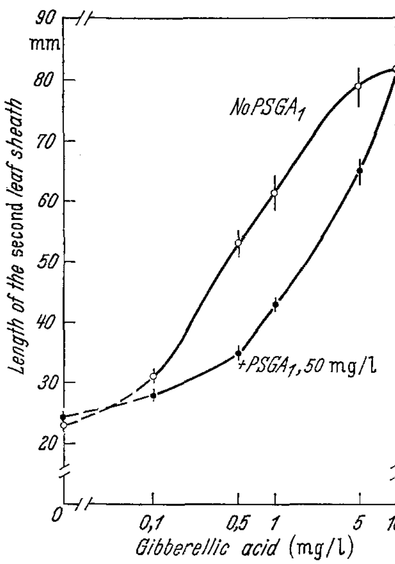

Fig. 1. Interaction of GA_3 and $PSGA_1$ in the rice seedling assay. Each point represents the mean length of the second leaf sheaths of either 9 or 10 plants. Standard errors are indicated by vertical bars

Contrary to the above observation $PSGA_1$ was found to be slightly active in the cucumber hypocotyl elongation and more active in the maize leaf sheath elongation (Table 1 and 2). As shown in Table 1 the interaction of $PSGA_1$ and GA_3 was simply additive in the cucumber assay.

Table 1. *Interaction of GA_3 and $PSGA_1$ in the elongation of the hypocotyl unit of light grown cucumber seedlings. GA_3 and $PSGA_1$ were applied separately to the apical bud as 10 µl drops (95% ethanol). Measurements were made three days after treatment. Each value represents the mean of measurements from 10 plants*

$PSGA_1$ µg/plant	Gibberellic adic, µg/plant					
	0	0.01	0.1	1	10	100
0	22.7±0.18	23.5±0.36	27.1±0.59	33.8±0.83	49.5±2.20	67.5±2.58
10	25.4±0.75	24.8±0.75	27.6±0.61	38.1±1.49	53.6±2.15	72.6±2.20

Table 2. *Effect of $PSGA_1$ on leaf sheath elongation of dwarf 5 mutants of maize. The compound was applied as a 10 µl drop (95% ethanol) to the first leaf blade. Measurements were made ten days after treatment. Each value represents the mean measurements from 7 plants*

	Control	$PSGA_1$, µg/plant		
		1	10	100
Length of the 1st + 2nd leaf sheath (mm)	39.7 ± 2.65	75.3 ± 5.15	91.2 ± 4.33	93.8 ± 5.73

The results suggest that in GA_3-induced elongation of the leaf sheath of rice seedlings the β-oriented hydroxyl group of the A ring is a structural requirement for biological activity. The data also emphasize that the structural requirements of the gibberellin molecule for biological activity varies depending on kind of plant tested.

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