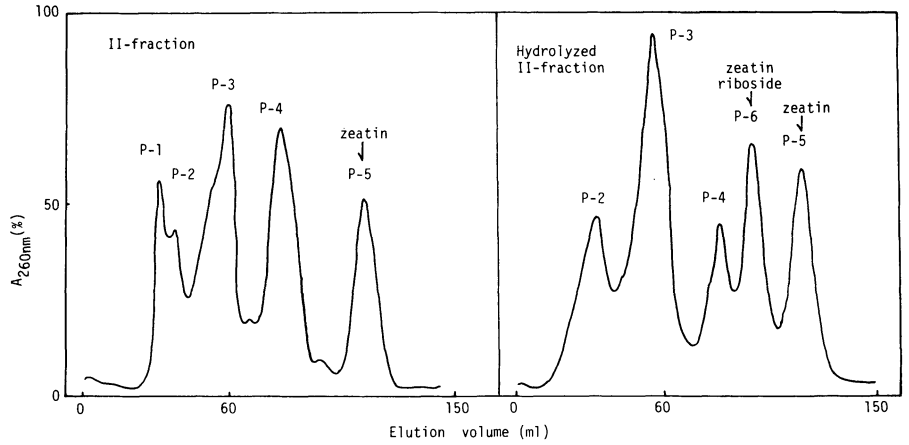

Fig. 3. Column chromatogram of II-fraction on Sephadex LH_{20} with 33% ethanol.

tissue has been induced by *Corynebacterium fascians* (4, 7, 11).

Table 1. GLC retention times of peaks from II-fraction and authentic compound on 3% SE_{52}.

Peak	Isothermal at 210°		Isothermal at 250°	
	Time (min)	Re (Kinetin)	Time (min)	Re Kinetin)
Peak-I	4.30	1.30	–	–
Peak-II	5.80	1.81	–	–
Kinetin	3.20	1.00	0.90	1.00
Zeatin	5.80	1.81	–	–
Zeatin riboside	–	–	9.40	10.44

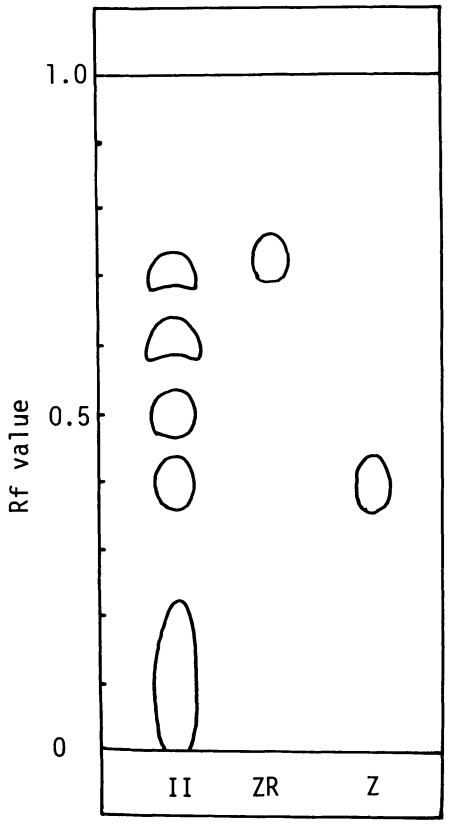

Fig. 4. Thin layer chromatogram of II-fraction. After developed with water, each spot was detected under UV at 366nm. Z:zeatin, ZR: zeatin riboside.

The factors isolated from liquid cultures of this organism were identified as 6-(γ,γ-dimethylallyl amino)purine, nicotinamide and 6-methylaminopurine. Likewise gall formation of cabbage and rape tissues is inducible with *Plasmodiophora brassicae* (5, 6, 9, 10, 12). The infected gall tissue contained significantly greater amounts of cytokinins than non-infected ones. The active factor involved in gall formation has also been identified earlier as cytokinin.

"Green islands" are well known symptoms of birch larvae of *Stigmella argentipedella.* These isolated larvae were reported to contain zeatin-like compound and its ribonucleotide which may have their origin in the labial glands of the larvae (1, 2, 3). The actual compounds were not identified.

Preliminary experiments in this laboratory indicate that zeatin injected into chestnut buds initiated gall formation. From these examinations, it is postulated that the larvae releases zeatin from its salivary glands similar to *S. argentipedella.* The continuous secretion of hormones by the larvae induced a profusion of undifferentiated cells leading to gall formation which inhibits terminal shoot growth and subsequent flower formation.

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Manganese Chelate Sprays Increase Growth and Yields of Peas[1]

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Abstract. **Manganese chelate sprays at bud formation, first bloom and a split application at bud formation and full bloom, increased vine growth of peas (*Pisum sativum* L.) Shelled pea yields increased with the following Mn chelate rates and timing: 134 g Mn/ha (1 lb. Mn chelate/acre) at first bloom, 269g Mn/ha (2 lb. Mn chelate/acre) at bud formation and first bloom; and with the split application of 134g Mn/ha at bud formation and 134g Mn/ha at full bloom. Tissue analyses showed that redistribution of foliar applied Mn to the non-sprayed new growth was negligible.**

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Mn deficiency in peas in British Columbia and northwestern Washington has occurred in mineral soils after lime applications raised the soil pH. Preplant broadcast manganese sulfate 38 kg Mn/ha increased shelled pea yields in northwestern Washington 2.5 fold over the deficient control (1). Deficiency symptoms in the foliage occurred when the tissue Mn concn was below 15 ppm (1).

Present soil tests for Mn have limited value in diagnosing crop response to Mn fertilization. Since Mn deficiency is often first observed as foliage symptoms, foliar applications are frequently the only practical method for treating crops in mid-season.

These experimental plots were adjacent to the Mn soil and seed studies reported earlier (1). Cultural methods and procedures for tissue analyses, growth and yield measurements were described previously (1). The Mn chelate sprays were applied with 468 liter/ha (50 gal/acre) water and 1.17 liter/ha (1 pt/acre) X-77 adjuvant. The plots were seeded to 'Darkskin Perfection' peas.

Foliage sampling was initiated 30 days after planting at first appearance of flower buds. At that time no visual Mn deficiency symptoms were evident. By the 49th day, Mn levels in the control treatment dropped below 15 ppm Mn and continued low through green harvest (Table 1). Treatments at bud formation were applied 31 days from planting and increased the tissue Mn level at the next tissue sampling. However, tissue Mn levels were comparable to the control by the 43rd day and continued to be low until harvest. The 269g Mn/ha application increased the tissue level over the 134g/ha treatment at the next sampling date but did not elevate Mn content in the sampled new leaf tissue grown after the treatment.

The first bloom treatments were applied 42 days after planting. Each increment in spray concn increased tissue Mn content. By the 64th day foliage Mn content of most plots was low. The exception was 538g/ha Mn treatment which was toxic as judged by reduced plant growth and pea yield.

The split spray application of 134g Mn/ha applied at bud formation (31 days) and again at full bloom (57 days) most effectively maintained elevated tissue Mn content during the fruit development phase of peas.

Henkens and Jongman (2) showed there was negligible redistribution of Mn in peas from the sprayed older foliage to newly developed unsprayed foliage. Our results are in agreement with them and indicate the split application was our best treatment in consistently maintaining the tissue Mn content at elevated levels.

Mn soil treatments, reported earlier (1), increased plant growth, especially fresh vine wt. Foliage spray treatments also increased fresh vine wt with the exception of the Mn spray of 538g/ha at first bloom (Table 2). Spray timing was important for growth, particularly at the lower Mn spray concns. The vine wt of plants treated with Mn at 134g/ha at first bloom was greater than plants treated with the same concn at bud formation. The 269g Mn/ha treatments were comparable in producing increased vine growth irrespective of whether application time was at bud formation, first bloom or a split application treatment at bud formation and at full bloom. The plants in the split application treatment were taller than the control (Table 2).

Yields of shelled peas were increased with the following Mn chelate treatments: 134g Mn/ha at first bloom, 269g Mn/ha at bud formation and first bloom; and the split application at bud formation and full bloom (Table 2). The timing of sprays affected pea maturity as measured by tenderometer. Peas from plants treated at bud formation were lower in tenderometer reading than plants treated at first bloom. Peas from plots which received 538g Mn/ha had higher tenderometer reading than the control.

Table 1. Effect of time and rate of Mn chelate foliar sprays on Mn content in young leaves sprayed at flower bud formation (31 days), first bloom (42 days), and full bloom (51 days).

Timing and rate (g Mn/ha)[z]	ppm Mn dry wt basis					
	Days after planting					
	30	37	43	49	64	68
Control	21 a[y]	16 a	23 a	13 ab	9 a	10 ab
Bud formation						
134	21 a	27 b	24 a	15 bc	10 ab	9 a
269	21 a	37 c	22 a	14 ab	9 a	10 ab
First bloom						
67	19 a	15 a	63 b	18 c	13 bc	11 abc
134	21 a	14 a	132 c	24 d	15 c	13 bcd
269	19 a	13 a	241 d	30 e	14 bc	16 d
538	20 a	13 a	631 e	119 f	52 d	35 e
Split application						
134 bud formation and 134 full bloom	20 a	24 b	21 a	12 a	16 c	14 cd

[z]1 lb./acre Mn chelate is equivalent to 134g Mn/ha.

[y]Mean separation within columns by Duncan's multiple range test, 5% level.

Table 2. Effect of timing and rate of Mn chelate foliar sprays on pea plant growth and yield.

Timing and rate (g Mn/ha)[z]	Vine wt (g/plt)	Plant ht (cm)	Shelled pea wt (g/plt)	Tender-ometer
Control	21 a[y]	54 a	4.3 a	93 ab
Bud formation				
134	30 b	58 ab	5.9 ab	91 a
269	34 bc	62 ab	7.2 b	92 a
First bloom				
67	32 bc	62 ab	6.1 ab	96 ab
134	37 c	62 ab	7.5 b	99 bc
269	36 bc	62 ab	7.1 b	99 bc
538	28 ab	57 a	5.3 a	102 c
Split application				
134 bud formation and 134 full bloom	35 bc	63 b	7.1 b	97 b

[z]1 lb./acre Mn chelate is equivalent to 134g Mn/ha.

[y]Mean separation within columns by Duncan's multiple range test, 5% level.

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