similar substance must be limiting, while 'florigen' is not.

In our experiments and especially in those of Paleg and Aspinall[3], it has been shown that applications of gibberellic acid at an early stage in the development (before the ten-leaf stage) will result in inhibition of flowering. Therefore this early application must either inhibit the formation of, or destroy, the florigen.

Hence, at least two things must happen during vernalization: (1) 'florigen' must be formed, or its formation induced after removal from cold; (2) a gibberellic acid-like substance must also be made, accumulated, or its formation induced so that it is formed soon after the plant is removed from the cold.

A more detailed report of this work is being prepared for publication elsewhere.

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Effect of Gibberellin on the Flower Initiation and Stem Extension in Petkus Winter Rye

The cold requirement for flower formation in biennial *Hyoscyamus niger* was shown by Lang[1] to be replaceable by application of gibberellin, but no flowering response was observed at that time in either Petkus winter or spring rye similarly treated[2]. In 1958, I attempted to supplement partial vernalization in Petkus winter rye by a single injection of gibberellic acid (10 p.p.m.) through the third leaf. No effect on flower initiation was observed. Stem extension was unaffected in the unvernalized controls but considerably enhanced in the partially vernalized series. In 1959, further work was carried out to determine whether the lack of response was due to the low concentration of the single application of gibberellic acid, or whether stimulation of stem extension demanded some prior degree of flower initiation.

Unvernalized winter rye was injected with gibberellic acid at 20 p.p.m.; this was done by feeding through the severed tips of mature leaves. Three groups received single injections to the third, sixth and ninth leaves, respectively, at the time when these had reached full expansion (that is, approximately at intervals of 3 weeks). In a fourth group the sixth and ninth leaves were injected as they reached maturity, while in a fifth group the third, sixth and ninth leaves were treated in turn.

The results are presented in Table 1, in which the effects on progress of flower initiation as 'scores' attained 93 days after planting, and on stem extension, are shown. 'Scores' less than 21 indicate that flower initiation (double ridges) had not been attained, while higher values mark progress beyond this stage.

Stem extension. A single injection at the third-leaf stage had no effect, as was also found in 1958. Single injections at the sixth or ninth leaf-stages resulted in limited stem extension (3 cm. in each case) apparently attained at a higher rate when the ninth leaf was treated. Multiple injections produced an effect rather more than proportional to the number of leaves injected. Thus an injection of the third leaf, apparently ineffective when this leaf alone was treated, intensified the response to treatment of later leaves.

Flowering response. The flowering response was entirely different. Injection of the third leaf resulted in a very small increase in 'score' just below the significant level. Injection of the sixth leaf resulted in a significant increase, which was further augmented by injecting the ninth leaf. Multiple injections effected no greater increase than that following a single injection of the ninth leaf; indeed, the triple injection decreased the score significantly below that due to the single injection.

Although the plants were not grown to maturity, it was evident that those injected through the ninth leaf alone would have produced ears free from morphological abnormalities. Where earlier leaves had been injected in addition, very many abnormalities were found, such as the formation of subsidiary ears from basal primordia ('miracle' ears), leafy outgrowths below the spikelets, or shortening and distortion of the peduncle[3]. This was also true to a lesser degree where the sixth leaf had been injected, but was not, of course, apparent in the undifferentiated apices of plants treated at the third leaf. These effects correspond closely with those obtained by Caso *et al.* (preceding communication).

Thus it appears that gibberellin has no direct effect on flower induction in Petkus winter rye, and therefore cannot replace low temperature in this respect; the accelerating effect on flowering would appear to operate at some post-inductive stage. The stimulus to stem extension only occurs either just before or after flower initiation has taken place.

Table 1. Effect of Injecting Unvernalized Winter Rye with Gibberellic Acid (20 p.p.m.) through Different Leaves

No. of injections Leaf injected	0 None	1 3	1 6	1 9	2 6 + 9	3 3 + 6 + 9
Score at time of injection		7·1 ± 0·34	9·6 ± 1·19	13·0 ± 0·91		
Score at 93 days	17·8 ± 0·39	←*NS*→ 19·2 ± 0·78	←*SS*→ 23·4 ± 0·66	←*SS*→ 27·8 ± 0·49	←*NS*→ 27·8 ± 0·40	←*S*→ 26·3 ± 0·58
Stem length at 93 days (cm,)	0	<0·5	3·0 ± 0·39	3·1 ± 0·50	7·7 ± 1·22	13·1 ± 1·80

N.S., Difference not statistically significant; *S.*, significant, $P = 0.05$; *S.S.*, highly significant, $P = 0.01$.

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