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Gibberellins and Nodulation

RECENTLY, Fletcher, Alcorn and Raymond[1] presented evidence that gibberellins had no effect on the nodulation of white clover (*Trifolium repens*) grown either in aseptic agar or in soil. In concentrations from 1 to 1,000 p.p.m., gibberellic acid was also without effect on the growth of the nodule-forming organism *Rhizobium trifolii*. These combined results seemed to contradict a previous report of Thurber, Douglas and Galston[2], who had found a marked depressive effect of potassium gibberellate on nodulation in dwarf beans (*Phaseolus vulgaris*).

Although I have done no further work on this phenomenon since the original report, I have been in receipt of information from other workers in the field, who have corroborated and extended our findings. For example, Dr. P. W. Brian, of Imperial Chemical Industries, Ltd., has informed me that 10 and 100 p.p.m. sprays of gibberellic acid, applied daily or weekly, greatly depressed the number of nodules and the mean diameter of nodules of 14-day old plants of *P. vulgaris* var. Masterpiece grown in garden soil.

Similarly, Dr. N. P. Kefford, of the Commonwealth Scientific and Industrial Research Organization, Division of Plant Industry, Canberra, has found a depressive effect of gibberellic acid at 0·3 p.p.m. on nodule formation of lucerne (*Medicago sativa*, Hunter River) grown for 42 days on mineral agar, the acid in these experiments being added directly to the agar. In this case, the fewer nodules were each of larger volume than the controls, so that the nodule volume per plant was unaltered by treatment with gibberellic acid. Both Dr. Brian and Dr. Kefford plan to publish their results in detail.

In view of these results, involving independent demonstration of the same kind of phenomenon in three widely separated laboratories, it would seem that the original conclusion that gibberellins can inhibit nodulation is valid, and that some care is therefore required in the use of this product on legumes. It is also clear from the work of Fletcher *et al.* that not all legumes grown under all conditions will show this inhibitory effect of gibberellic acid. This difference in nodulation response is probably related to the already known fact that different genotypes of plants, presumably of varying endogenous gibberellin-levels, react quite differently to identical gibberellin applications.

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Quantitative Measurement of the Effect of Lysergic Acid Diethylamide on Mice and its Interactions with other Drugs

ALTHOUGH several species of animals (including spiders, fighting fish, pigeons and rats) have been used for the quantitative evaluation of the effect of hallucinogenic and psychotomimetic agents it is worth while to add to this list owing to the biochemical differences between species. The present favourite seems to be the rat[1]. This communication reports a test for the quantitative evaluation of the effect of psychotomimetic agents using mice chosen for their small size (useful if limited quantities of agent—for example, extracts from schizophrenic serum—are available) and ease of handling. A Latin square design was used employing four cages, each of 5 mice, and four modes of injection (saline, lysergic acid diethylamide, drug to be tested, and lysergic acid diethylamide and this drug together). The mice were injected subcutaneously and placed individually on the centre of a vertical pole at 1 min. intervals. The time (up to a maximum of 40 sec.) taken by the mice to reach lines drawn 1 in. from the top or bottom of the pole was then measured. Variability can be reduced by eliminating slow or erratic mice in preliminary tests. (The mice can also be trained to run down the pole under hunger drive. This procedure, however, introduces two new parameters—learning and hunger—which may be differentially affected by drugs.) Doses of lysergic acid diethylamide of 1 and 2 mgm./kgm. were used. The solutions were always freshly prepared and the effect tested of their interaction with adrenochrome, adrenolutin and the brom derivative of lysergic acid diethylamide. Fig. 1 shows the difference between the drug value and its matching saline value, with the latter corrected to a straight line at the level of the first saline value (maximum possible score = 200). All statistical work was done, however, on uncorrected results. As the results obtained were not normally distributed, all statistical evaluations were carried out using non-parametric methods (Wilcoxon's method for paired data).

It was found that lysergic acid diethylamide increases the time which the mice take to reach the end of the pole. This is maximum at 10–15 min. after injection and is still appreciable after 30 min. Bufotenin in doses up to 20 mgm./kgm. did not show any of this effect (nor any qualitative change). Adrenochrome in doses of 10 and 20 mgm./kgm. has no effect on mice demonstrable by this test or on the effect of lysergic acid diethylamide on mice. Adrenolutin inhibits the effect of lysergic acid diethylamide on mice but exerts no influence by itself in a dose of 20 mgm./kgm. (Fig. 1). This effect was confirmed in a further experiment using 40 trained hungry mice and 30 mgm./kgm. adrenolutin (P for the interaction of lysergic acid diethylamide and adrenolutin is between 0·02 and 0·05). The brom derivative of lysergic acid diethylamide in a dose of 1 mgm./kgm. produced a marked sedation of untrained mice and a delayed time for descending the pole. The same dose did not produce this effect in trained or hungry mice where, presumably, the sedative effect could be overcome by motivation or training. The morpholide derivative of lysergic acid diethylamide is less active but causes a late acceleration of the mice (at 30–60 min.: $P = 0{\cdot}02$).

The purpose of this test is to evaluate the effect of lysergic acid diethylamide and other psychoto-