When the larvae were treated with 0·45 μg/larva, the mortality was 4% only and the deformity effect was 96%. Thus no emergence of adult moth took place. The deformity has been noted earlier by Hathaway, Lydin and Butt[1], Nagasawa and Nakayama[2], and Nakayama, Agmi and Yagi[3] in the case of other chemosterilants. The present authors have not come across any report on the formation of deformed individuals after treating with Penfluron.

FIG. 1. Control pre-pupa of *Spodoptera litura*.

FIG. 2. *Treated pre-pupa* (larva-pupa intermediate) after treatment with 0·45 μg/larva Penfluron.

In the present study the deformed individuals were all of larva–pupa intermediate type, *i.e.*, the treated larvae could not metamorphose completely. The metamorphosed individuals were more like in a pre-pupal condition—the head and thorax retaining the larval characters whereas the abdominal cuticle was of the intermediate pupa type. Another important point in this study was that the chemical caused 100% deformity amongst the survivors.

Toxicological Laboratory, (Km.) SUDHANSHU DWIVEDI.
Zoology Department, A. N. CHATTORAJ
University of Allahabad,
Allahabad 211 002,
March 13, 1980.

1. Hathaway, D. O., Lydin, L. V. and Butt, B. A., *Jour. Econ. Entomol.*, 1966, **59**, 851.
2. Nagasawa, S. and Nakayama, I., *Applied Entomology and Zoology*, 1974, **9**, 159.
3. Nakayama, I., Agmi, H. and Yagi, S., *Botyu-Kagaku* 1977, **42**, 50.

INFLUENCE OF DIKEGULAC-SODIUM ON CHLOROPHYLL DEGRADATION AND CHLOROPHYLLASE LEVEL IN DETACHED LEAVES OF *AVENA SATIVA*

DIKEGULAC-SODIUM (sodium-2,3 : 4,6-di-O-isopropylidene-α-xylo-2-furanosonate) or ATRINAL[R] is a biologically active new growth regulator and exhibits a broad spectrum of diverse effects on plant growth and development[2–9]. It inhibits chlorophyll biosynthesis[2,6]. Recently, Purohit and Chandra[9] studied the individual and combined effects of dikegulac and GA_3 on chlorophyll biosynthesis of *Avena sativa* and proposed a model pertaining to the possible mode of actions of dikegulac on degradation/inhibition of chlorophyll biosynthesis in leaves. The model suggests that dikegulac may act either (i) by inhibiting hormonal (GA, IAA and cytokinins) activity and by interacting with hormonal-induced other growth regulatory activities responsible for chlorophyll biosynthesis[2,8,9] or (ii) by suppressing rRNAs incorporation into plastid nucleic acid and its synthesis[4] or (iii) by inhibiting GA-dependent DNA biosynthesis which decreases protein content necessary for chlorophyll biosynthesis[2] or (iv) by direct involvement in increasing chlorophyllase synthesis induced by ethylene. Level of ethylene increases to six-fold after dikegulac treatment[3]. The last possible mode of action on chlorophyll inhibition and chlorophyllase activity on *A. sativa* is yet to be confirmed. In this report the effects of dikegulac-sodium on chlorophyllase level in detached leaves of *A. sativa* are reported.

Seeds of *A. sativa* were sown in plastic trays containing ordinary soil mixed with farm yard manure under natural day (11–13 h) and temperature (25°–32° C) Two week old leaves of similar shape, colour, size (10 mm) were cut from both ends and floated on distilled water or test solutions (kinetin 30 mg/l), dikegulac 50 and 100 mg/l). Chlorophyll of leaves was estimated[1]. For the determination of chlorophyllase activity 25 g of leaves were ground in chilled mortar and pestle and was mixed with 125 ml of chilled acetone and washed with ethyl ether. The filtrate was dried at room temperature and was stored in refrigerator. The residue was assayed for chlorophyllase activity according to Holden[10]. The preparation and assays of chlorophyllase were made in triplicate.

TABLE I

Effect of dikegulac-sodium and kinetin on chlorophyll retention by leaves of Avena sativa

Treatment (mg/l)	Chlorophyll retention mg/g fresh leaves				
	24 h	48 h	72 h	96 h	120 h
H_2O	13·6	10·0	6·0	4·1	3·1
Kinetin 30	15·3	12·1	10·1	9·0	7·9
Dikegulac 50	9·1	6·1	4·0	2·6	1·1
Dikegulac 100	5·0	4·5	3·0	1·8	0·9
Kin. 30 + Dik. 50	12·1	8·5	6·3	4·8	4·5
Kin. 30 + Dik. 100	10·2	6·7	4·8	2·5	2·0
F	26·83	14·98	7·56	70·37	88·59
S Em ±	1·72	1·74	2·10	0·77	0·41
L S D (0·05)	3·63	3·68	4·43	1·62	0·87

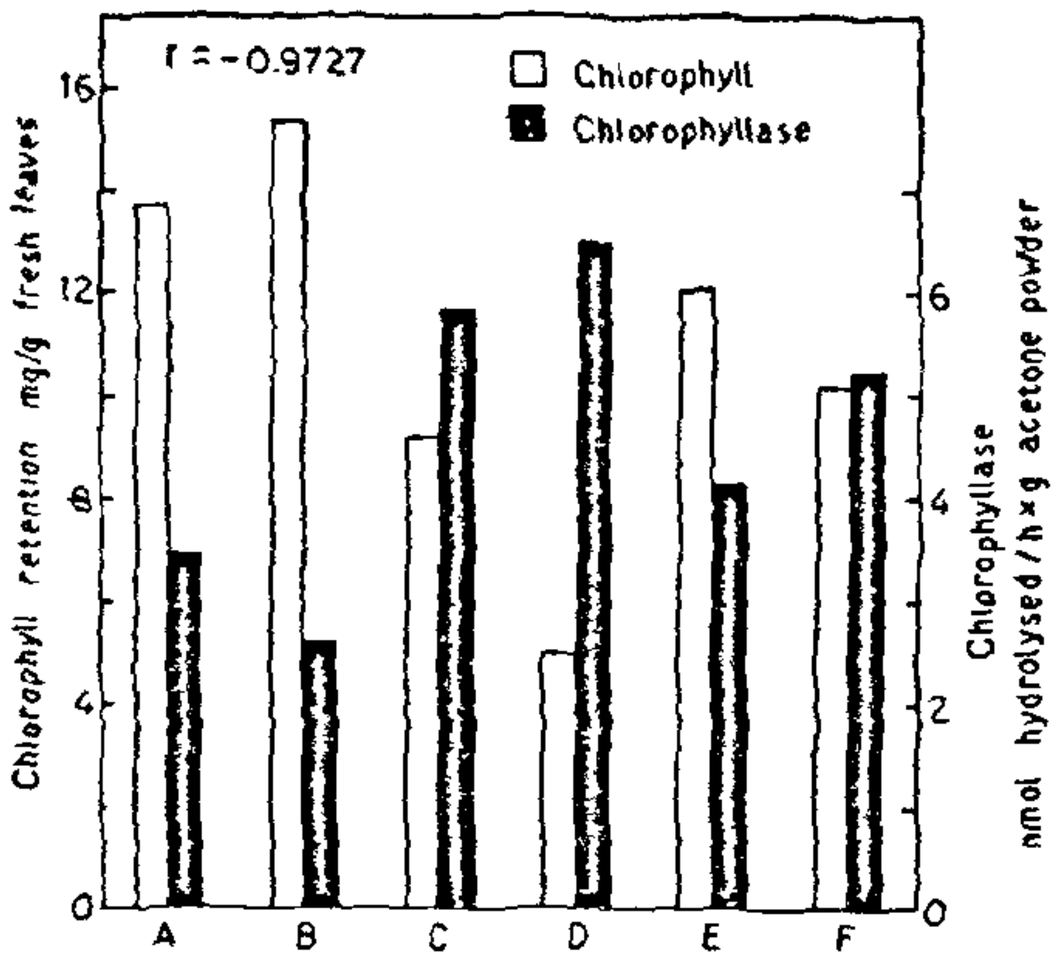

FIG. 1. Effect of dikegulac and kinetin, used alone and in combination, on chlorophyll retention and chlorophyllase activity in detached leaves of *Avena sativa*. Leaves were floated for 24 hours at 30° C. The values are mean of three determinations. All the experimental values are within 10% from the mean. The treatments are indicated as A = Water; B = Kinetin 30 mg/l ; C = Dikegulac 50 mg/l ; D = Dikegulac 100 mg/l; =E =Kinetin 30 mg/l + Dikegulac 50 mg/l ; F = Kinetin 30 mg/l + Dikegulac 100 mg/l.

Data presented in Table I revealed that all the concentrations of dikegulac inhibited chlorophyll content while kinetin had the opposite effects against chlorophyll loss. These effects were pronounced after 24 h of floating. The relation between chlorophyll loss and chlorophyllase activity in 24 h floated leaves is presented in Fig. 1 which suggests that chlorophyllase is involved in the protective effect of kinetin against chlorophyll loss. The value of Karl Pearson's coefficient of correlation ($r = -0{\cdot}9727$) between chlorophyll retention and chlorophyllase level suggests that the negative correlation is highly significant.

Recently, Sabater and Rodriguez[11] observed that loss of chlorophyll during senescence of detached leaves of *Avena sativa* is controlled by chlorophyllase enzyme. Similarly, Shimokawa *et al.*[12] observeed enhancement of chlorophyllase activity after ethylene treatment in *Citrus unshiu*. Ethylene level increases six-fold after dikegulac treatment and kinetin interacts with dikegulac[3]. Therefore, it is possible that dikegulac may directly enhance chlorophyllase or indirectly by enhancing ethylene level, which in turn increases the enzyme. Further work is in progress.

We are grateful to Dr. R. Maag Ltd., Switzerland and to Dr. Gerard W. M. Barendse, Katholiek University, Nijmegen, The Netherlands, for help.

Department of Botany, Government Post-Graduate College, Nagaur 341 001 (India),
March 14, 1980.

S. S. PUROHIT.
K. CHANDRA.

R = Registered Trade Mark of Dr. R. Maag Ltd., Switzerland.

1. Arnon, D. I., *Plant Physiol.*, 1949, **24**, 1.
2. Arzee, T., Langenauer, H. and Gressel, J., *Bot. Gaz.*, 1977, **138**, 18.
3. Bocion, P. F. and DeSilva, W. H., "Some effects of dikegulac on the physiology of whole plants and tissue : Interaction with plant hormones," In *Plant Growth Regulation*, P. E. Pilet, ed., Springer-Verlag, 1977, p. 189.
4. Gressel, J., Kadouri, A., Atsmon, D. and Cohan, H., "Collections of abstracts of paper demonstrations," In *Plant Growth Regulation*, 9th International Conference on Plant Growth Substances, P. E. Pilet, ed., Springer-Verlag, 1977, p. 177.
5. Purohit, S. S., *Comp. Physiol. Ecol.*, 1979, **4**, 264.
6. —, *Ibid.*, 1980, **5**, 24.
7. —, *Ibid.*, 1980, **5**, 83.
8. —, Ibid., 1980, **5**, 159.
9. —and Chandra, K., *Comp. Physiol. Ecol.* (In press).
10. Holden, M., *Biochem. J.*, 1961, **78**, 259.
11. Sabater, B. and Rodriguez, M^a. T., *Plant Physiol.*, 1978, **43**, 274.
12. Shimokawa, K., Shimada, S. and Yaco, K., *Sci. Hort.*, 1978, **8**, 129.