than in the present specimens. *W. setosa* (Nathorst) and *W. mirabilis* Braun possess 20 microsorophylls in a whorl[4]. *W. whitbiensis* (Nathorst) of the Yorkshire Jurassic flora[4] and also occuring in West Malaysia[6] looks very similar to the Malda specimens and have almost similar number of segments (13–16), but differs from the present materials by having segments which are shorter in length. As such, the present specimens with distinctive characteristics are designated *Weltrichia maldaensis* sp nov; the specific epithet being after the locality where the fossil comes from.

Chandra and Ghosh[7] published the palynological details of the Milki bore hole. They described several pteridophytic spores and gymnospermous pollen grains from samples between 110 m to 254 m levels and suggest that these are comparable with the Rajmahal flora of Upper Jurassic age. Almost all other records of *Weltrichia* are Upper Jurassic in age. The present finding of *W. maldaensis* in the subcrops of West Bengal is in conformity with the palynological results.

We thank the Director General and the Sr. Dy. Director General, Geological Survey of India for their kind permission to publish this account.

14 February 1985

1. Carruthers, W., *Linn. Soc. London Trans.*, 1870, **26**, 675.
2. Braun, C. F. W., *Flora, Regensburg*, 1847, **30**, 705.
3. Bose, M. N., *Curr. Sci.*, 1967, **2**, 48.
4. Harris, T. M., *Yorkshire Jur. Flora*, 1969, **3**, 1.
5. Shitholey, R. V. and Bose, M. N., *Palaeobotanist*, 1953, **14**, 29.
6. Asama, K., *Contr. Geol. Palaeontol. Southeast Asia*, 1974, **14**, 83.
7. Chandra, A. and Gosh, S. C., *Rec. Geol. Surv. India*, 1976, **109**, 140

JUVENOID ACTIVITY IN EXTRACTS OF CERTAIN PLANTS

U. S. SRIVASTAVA, A. K. JAISWAL and REHANA ABIDI

Sheila Dhar Institute of Soil Sciences, University of Allahabad, Allahabad 211 002, India.

IN 1961, Schmialek[1] discovered a juvenilising substance in the excrements of *Tenebrio molitor* and identified it as farnesol which is a component of the essential oils of certain plants. When he treated insects with farnesol itself, he found that it showed very low but distinct juvenile hormone-like activity. Four years later, Slama and Williams[2] discovered that the paper used in certain American newspapers contains a factor which mimics juvenile hormone in respect of its effect on insects. This well known "paper factor" was later traced in the wood of balsam fir from which the paper pulp is produced[2,3]. About the same time, Nakanishi *et al*[4] reported the occurrence of a moulting hormone substance in the evergreen plant *Podocarpus nakai*. Moulting hormone substances have been discovered in several ferns and other plants also.

In view of the suggestion of Williams[5] that juvenile hormone mimics may be used as third generation pesticides to control insect pest populations and the above mentioned examples showing that hormonally active substances occur in plants, there has been a search for insect growth regulators in plants. Stall[6] assayed a large number of ever green plants for juvenoid activity, using impregnated paper discs for contact with *Dysdercus* nymphs but obtained more or less negative results with all the plants tried. In fact, the extract of the wood of the balsam fir *Abies balsamea* also did not give him positive results. On the contrary, Tarnepol and Ball[7] reported that out of 48 species of flowering plants which they assayed on *Tenebrio molitor* pupae, five showed limited juvenoid activity. Saxena and Srivastava[8,9] also reported strong juvenoid activity in *Iris insata* and *Tagetes minuta* against *Dysdercus cingulatus*.

The occurrence of insect growth regulating substances in plants is evidently related to their metabolic activity and physiological state which may differ from season to season, place to place and in different parts of the same plant. In view of the potential which insect growth regulators of plant origin possess for pest control, it appeared worthwhile to undertake a survey of Indian plants for the presence of juvenoid activity. In the present communication, the results of the bioassay of extracts of 20 flowering plants is being reported, using *D. cingulatus* as the test insect.

Shade dried plant material was soxhlet extracted with petroleum ether (B.P. 40–60°C). The extract was filtered and evaporated under reduced pressure. The residue was extracted with acetone and the acetone extract was concentrated at room temperature under reduced pressure. The residue was redissolved in acetone and 1 μl of this solution containing 500 μg of the residue was topically applied to the dorsum of the early 5th instar nymphs of *D. cingulatus* with the help of a microapplicator. Controls were similarly treated with an equal quantity of acetone only. The experimental insects (0–15 hr old 5th instar nymphs) were maintained at 25° ± 2°C on soaked cotton seeds.

When the nymphs moulted, the emerging insects were examined for their adult/nymphal characters. These insects were roughly divided into 5 categories, rated 0 to 5, on the basis of the extent of adult/nymphal characters.

Rating:
- 0 – Normal adult
- 1 – Adult with 3 nymphal dorsal abdominal spots.
- 2 – Adultoids with crumpled wings and dorsal abdominal spots as above.
- 3 – Adultoids with crumpled wings, dorsal abdominal spots and 2-segmented tarsi.
- 4 – Nymphoids with wing pads, dorsal abdominal spots and 3-segmented tarsi.
- 5 – Supernumerary nymphs with wing pads, dorsal spots and 2-segmented tarsi.

Twenty five nymphs were treated with each extract and each nymph was individually rated. The average rating of the 25 specimens treated with a particular extract was calculated to find the juvenilising activity of each extract[10].

It is seen from table 1 that out of the 20 plants studied, 13 show juvenilising effect on *D. cingulatus*. The maximum activity was shown by (a) *Ageratum conyzoides* (wp), followed successively by (b) *Tridex procumbens* (wp), (c) *Artimisia maritima*, (d) *Pterothea falconeri*, (e) *Allium sativum* and *Hibiscus rosa-sinensis*, (f) *Allium cepa*, *Citrus sinensis* (ep. fr.) and *Citrus arvensis* (ep. fr.), (g) *Bauhinea variegata*, (h) *Zingiber officinale* (Rh) and (i) *Bougainvillia glabra* and *Nyctanthes arbor*.

The data given above reveal a few interesting points. Of the thirteen plant families, family Compositae has provided the maximum number of juvenoid-rich representatives and also that these contain the most active principles. Earlier workers have also reported the presence of juvenoids in the Compositae *viz Tagetes minuta*[9], *Parthenium hysterophorus*[11], *Nephrolepsis exaltata*[11] and *Echinacea augustifolia*[10]. Representatives of 6 families have been reported to show juvenoid activity in the present work for the first time. These are Liliaceae, Malvaceae, Oleaceae, Nyctaginaceae, Zingiberaceae and Rutaceae. Some other members of Ceasalpinoideae, Euphorbiaceae

Table 1 *Effect of 500 μg/insect of crude concentrated plant extract on D. cingulatus nymphs.*

Family	Botanical name	Month of collection	Part extracted	Average rating
Achyranthaceae	*Achyranthes aspera*	Aug–Sept	Wp	0
Amaranthaceae	*Amaranthus oleracea*	July	Wp	0
Amaranthaceae	*Digeria arvensis*	July	Wp	0
Caesalpinoidae	*Bauhinea variegata*	June	St	1.40
Compositae	*Ageratum conyzoides*	Sept–Oct	Wp	3.20
Compositae	*Artimisia maritima*	Sept–Oct	Wp	2.20
Compositae	*Pterothea falconeri*	Sept–Oct	Wp	2.00
Compositae	*Tridex procumbens*	Oct–Nov	Wp	2.52
Compositae	*Vernonia elegans*	Nov–Dec	Wp	0
Cruciferae	*Raphanus sativa*	Jan	Sd	0
Euphorbiaceae	*Croton bonplondianum*	Apr	St	0
Liliaceae	*Allium cepa*	Apr	St	1.80
Liliaceae	*Allium sativum*	March	St	1.92
Malvaceae	*Hibiscus rosasinensis*	April	St	1.92
Nyctaginaceae	*Bougainvillea glabra*	April	St	1.20
Oleaceae	*Nyctanthes arbor*	Oct–Nov	Fl	1.20
Rutaceae	*Citrus sinensis*	Dec	Ep. fr	1.80
Rutaceae	*Citrus arvensis*	Dec	Ep. fr	1.80
	Citrus arvensis	Dec	L	0
Verbenaceae	*Tectona grandis*	Aug–Sept	St	0
Zingiberaceae	*Zingiber officinale*	Sept	Rh	1.35
	Zingiber officinale	Sept	L	0

Wp = whole plant; St = stem; Sd = seed; Rh = rhizome; Ep. fr = epicarp of fruit, Fl = flower; L = leaves and Verbenaceae have been reported to possess juvenoid activity by earlier workers[12,13]. Further it may be noted that the extract of the epicarp of fruits of *Citrus sinensis* and *Citrus arvensis* showed juvenoid activity but their leaves did not. In fact, as much as 3 times the dose (1500 μg) of the leaf extracts of these plants did not produce any effect. Likewise, the extract of the rhizome of *Zingiber officinale* yields juvenoid-active factor but its leaves do not. The observations do not support the view of Slama[3] that generally speaking plants which possess the juvenoid principle contain these more frequently and abundantly in the root system.

Thanks are due to University Grants Commission, New Delhi for grant of financial assistance to USS and Dr V. K. Verma, Department of Botany, University of Allahabad for identification of plants.

1 January 1985

1. Schmialek, P., *Z. Naturforsch.*, 1961, **16b**, 461.
2. Slama, K. and Williams, C. M., *Proc. Natl. Acad. Sci.*, USA, 1965, **54**, 411.
3. Slama, K. and Williams, C. M., *Biol. Bull.*, 1966, **130**, 235.
4. Nakanishi, K., Koreeda, M., Sesaki Chang, M. L. and Hsu, H. Y., *Lloydia*, 1975, **38**, 445.
5. Williams, C. M., *Nature (London)*, 1956, **178**, 212.
6. Staal, G. B., *Proc. Kon. Ned. Acad. Wetensch.*, 1967, **C70**, 409.
7. Tarnepol, J. H. and Ball, J. H., *J. Econ. Ent.*, 1971, **65**, 980.
8. Saxena, B. P. and Srivastava, J. B., *Experientia*, 1972, **28**, 112.
9. Saxena, B. P. and Srivastava, J. B., *Indian J. Exp. Biol.*, 1973, **11**, 56.
10. Jacobson, M. M., Redfern, R. E. and Millis, G. D., *Lloydia*, 1975, **38**, 445.
11. Rajendran, B. and Gopalan, M., *Indian J. Agric Sci.*, 1980, **50**, 781.
12. Prabhu, V. K. K., John, M. and Ambika, B., *Curr. Sci.*, 1973, **20**, 725.
13. Prabhu, V. K. K. and John, M., *Entomol. Exp. Appl.*, 1975, **18**, 87.

A JUTE MUTANT WITH IMPROVED SEED YIELD COMPONENT

S. CHATTOPADHYAY, G. C. MITRA and S. L. BASAK
Jute Agricultural Research Institute, Barrackpore, 743 101, India.

In a self-pollinated species variability is created by inducing mutation by physical and chemical mutagenic agents[1]. Various kinds of x-ray induced mutants of jute have been reported earlier[2–4]. It was also observed[5,6] that the frequency of mutation could be increased considerably by using combination of physical and chemical mutagens. From one such combined treatment, oval pod with higher number of seeds per pod, of jute (*C. olitorius*) has been isolated and preliminary study on this mutant is reported here.

The mutant with oval pod and higher number of seeds per pod was isolated in M_3 generation of *olitorius* variety JRO 632 after combined treatment with x-ray (40 kR) and ethyl methane sulphonate (1%). The mutant bred true in subsequent generations. Cross section of the ovary of the above mutant showed 14–16 locules as opposed to 5–6 locules per ovary of the standard *olitorius* variety, JRO 632. The increase in the number of carpels in the ovary of this mutant was also evident from the separation of locules in the mature pod (figures 1, 2). The mean values of the different related characters of the standard variety and those of the mutant are shown in table 1 and each of the character pair differed significantly at 1% level. The ovalness of the pod of the mutant can be ascertained from the reduction of length, increase of diameter and also smaller length/diameter ratio in comparison to those observed in the standard one. Since the carpel number increased double fold, the number of seeds per pod of the mutant increased one and half times. The number of seeds per gram was much smaller in mutant than in the standard, indicating higher seed weight of individual seed of the mutant. Through the increase of the number as well as the individual seed weight the total seed weight per pod of the mutant has increased doubly over the standard one. Cylindrical type of pod is a species character of *C. olitorius* and hence a mutation to oval pod from cylindrical type, resembling that of *C. capsularis* is considered to be a case of macromutation.

As the mutant produces more number of seeds per pod with an increased weight of the individual seed, it is likely to prove useful towards improving seed yield of *olitorius* jute.