Indian J. Plant Physiol., Vol. 8, No. 1, (N.S.) pp. 82-84 (Jan.-Mar., 2003)

SHORT COMMUNICATION

ETHYLENE IN FLORAL MALFORMATION IN MANGO (*MANGIFERA INDICA* L.) CV. AMRAPALI

D. PANDEY*, S.N. PANDEY AND R.K. PAL

Division of Fruits and Horticultural Technology, Indian Agricultural Research Institute, New Delhi–110 012

Received on 20 Feb., 2002, Revised on 5 Feb., 2003

Studies were conducted to find out the association of different types of bud and ethylene production in shoot with expression of floral malformation in mango (*Mangifera indica* L.) cv. Amrapali. Shoot bearing simple (solitary apical) and multiple (apical and axillary buds with several protuberances at their base) buds were selected for this study. Data on the ethylene evolution from bud, stem, leaf and panicle and malformation incidence on those shoots revealed that multiple buds produced very high proportion of malformation (67.81%, 96.42%) than the simple buds (13.68, 4.89%) in 1993 and 1994 respectively. Similarly, the malformed panicle developed from multiple buds released more ethylene content (0.0235 µl g^{-1} h^{-1}) compared to normal panicle developed from simple bud (0.0160 µl g^{-1} h^{-1}). Ethylene evolution was also more (0.0177 µl g^{-1} h^{-1}) in multiple buds than that in simple buds (0.0143 µl g^{-1} h^{-1}).

Key words : **Ethylene, floral malformation, multiple buds, simple bud.**

Mango malformation has become one of the most serious problems in mango in India and in many other mango growing countries of the world (Pandey and Pandey 2000). Floral malformation causes heavy loss in yield and is characterized by a condensed mass of flower buds. Loss of apical dominance is one of the reason for floral malformation, in which isodiametric growth of rachis and shortening and thickening of secondary branches of panicle occur (Singh and Dhillon 1990c). The complex nature of this malady is obvious by the diverse claim regarding its cause viz., mite, virus, fungus and physiological and biochemical imbalances (Pandey and Pandey 2003). However, the precise cause and control of this malady is not clearly understood so far. The symptom of malformed and healthy panicles have been described by various workers at its full-grown stage (Singh *et al.* 1961 and Pandey and Pandey 2001) but very little information is available to distinguish healthy and malformed floral buds at an early stage of their development. Ethylene is reported to suppress apical dominance in plants (Ables 1973) and 'Amrapali' has been reported to be highly susceptible to floral malformation (Pandey and Pandey 2000). The present investigation was therefore, undertaken to find out associations between type of bud and level of ethylene evolution and occurrence of floral malformation in mango cv. Amrapali.

The present study was conducted in the Division of Fruits and Horticultural Technology, IARI, New Delhi during 1993 to 1995. Trees of cv. Amrapali (9-11 years old maintained under uniform cultural operations were selected for the study. Approximately 100-150 shoots containing simple (solitary apical) and multiple (apical and axillary buds with several protuberances at their bases) floral buds were tagged each year at bud-burst stage in February. Observations on incidence of floral malformation percentage in these buds were recorded at the time of flowering and data were statistically analyzed. In 1995, these tagged shoots bearing simple and multiple buds were studied for the rate of ethylene evolution from their bud, stem, leaves and also from panicles developed from these two types of buds. The floral buds, stems (1.0-1.5 cm just below the bud) and 3-4 leaves adjacent to the buds were severed, weighed and kept in the tube (60ml

Corresponding author's present address : Central Institute for Subtropical Horticulture, Rehmankhera, P.O. Kakori, Lucknow-227 107.

capacity) in February. These tubes were immediately capped with rubber septum and incubated for 5 hours at room temperatures (25 ± 2° C). Similarly, the healthy and malformed panicles arisen from simple and multiple buds respectively were also sampled in March in air tight glass jars for estimation of ethylene evolution using GLC. One ml of sample from each tube was injected into a Hewlett Packard Model 5890A gas chromatograph equipped with flame ionization detector and a stainless steel column packed with Porapak (80/100 mesh). The gas chromatograph was operated under following conditions: hydrogen flow 30 ml/min., air flow 380-400ml/min., nitrogen gas flow 30 ml/min., injector temperature 110°C, detector temperature 275°C and column temperature 60°C. Before starting analysis the column was conditioned at 250°C for at least two hours. Retention time, peak height and area were identified and compared with standard ethylene gas in Argon having 105 VPM concentration obtained from EDT Research, 14, Trading Estate Road, London. The ethylene content in the sample was identified by comparing the retention time of the sample to those of standard (1.6 min.). For quantification, the respective area of the identified peak was measured and calculated with the help of standard one and expressed as μ l g^{-1} h^{-1} on fresh weight basis.

The results on floral malformation in simple and multiple buds and ethylene evolution in different parts of their shoots are presented in Tables 1 and 2 respectively. The data presented in Table 1 clearly show that the multiple buds gave very high proportion of malformation (67.81% and 96.42%) in both years (1993 and 1994) as compared to simple buds (13.6% and 4.89%). These results are in agreement with earlier report that apical floral buds with many protuberances at their base terminated into malformed panicles (Singh and Dhillon 1990a) and higher endogenous levels of cytokinin in malformed panicles at various developmental stages may promote cell division in malformed panicles (Singh and Dhillon 1990b). Similarly, several protuberances below the main bud were reported to have been formed as a result of uncontrolled proliferation of cells caused by hormonal imbalances (Pandey *et al.* 1974). The data regarding ethylene evolution (Table 2) showed that the malformed panicle released the maximum content of ethylene (0.0235 μl g^{-1} h^{-1}) followed by multiple buds (0.0177 μl g^{-1} h^{-1}) as compared to normal panicle (0.0160 μl g^{-1} h^{-1}) and simple bud (0.0143 μl g^{-1} h^{-1}). Singh and Dhillon (1990c) reported that malformed panicle and shoot bearing malformed panicle and leaves born on such shoot contained higher level of ethylene than healthy panicles. It was suggested that the higher level of ethylene in malformed panicles could be playing a role in suppressing apical dominance of the panicle, increasing isodiametric growth and shortening and thickening of the secondary branches of malformed panicle thereby producing overcrowding of flowers. Similar effect of ethylene on plants have already been reported (Ables 1973). On the other hand, the stem and leaves of shoot bearing simple bud evolved higher amount of ethylene in the present study than stem and leaf of shoot bearing multiple buds. The greater evolution of ethylene in stem and leaf of shoot bearing simple bud could be due to the fact that bit higher amount of ABA found in the stem might have increased the ethylene evolution (Pandey 1996). Also the rise in ethylene evolution from leaf of shoot appeared to have been caused by high amount of IAA present in leaf of shoot bearing simple bud which might have promoted ethylene production by inducting the synthesis of ACC synthase responsible for the production of ethylene (Mckeon and Yang 1987). However, the increased level of ethylene in the present study do not appear to have reached the critical level to cause malformation in simple buds. Thus it is suggested that multiple buds produce more ethylene, which causes hormonal imbalance in buds which could be one of the causes for malformation in mango.

Table 1. Floral malformation in 'Amrapali' mango at bud-burst stage.

Bud type	1993				1994				Malformation (%) (mean of two years)
	Bud studied	Healthy panicles	Malformed panicles	Malformation (%)	Bud studied	Healthy panicles	Malformed panicles	Malformation (%)	
Simple	95	82	13	13.68	143	136	7	4.89	9.28
Multiple	87	28	59	67.81	140	5	135	96.42	82.42

Table 2. Ethylene evolution in 'Amrapali' mango.

	Ethylene evolution ($\mu l g^{-1} h^{-1}$)	
Shoot part	**Shoot bearing simple bud**	**Shoot bearing multiple buds**
Bud	0.0143	0.0177
Stem	0.0053	0.0013
Leaf	0.0040	0.00097
Panicle	0.0160*	0.0235**
	*Healthy	**Malformed

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