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Induction of flowering and fruiting in unproductive 'Chausa' mango orchards in Himachal Pradesh

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ABSTRACT

Despite of the healthy vegetative status of the trees, 'Chausa' mango orchards were being reported unfruitful after 10 to 15 years of bearing in the low hilly regions of Himachal Pradesh. A twenty two year old unproductive Chausa mango orchard was selected and plants were treated with different growth influencing practices and chemicals for induction of flowering and fruiting. Pre-bloom paclobutrazol (PBZ), cycocel and ethrel sprays induced flowering but did not affect fruiting significantly. PBZ and cycocel treatments followed by boric acid spray at fruit set succeeded in inducing fruiting and produced fruitful results. Ethrel spray was found effective when it was followed by NAA spray at the time of fruit set.

Keywords : Paclobutrazol, cycocel, ethrel, ringing, vegetative growth, yield

INTRODUCTION

Drive for commercial cultivation of mango in Himachal Pradesh gained momentum during early eighties and since then tremendous area has been brought under its cultivation. Presently, as per records of Department of Horticulture, Himachal Pradesh more than 35,000 hectare of land has been covered under mango in the state (Anon 2007). A good number of 'Chausa' mango plantations have also been established. Initially these plantations were good producers of mango crop but after 10 – 15 years of bearing the flowering and fruiting ceased and vegetatively these trees became sturdy. Keeping in view the general bearing tendency of 'Chausa' cultivar the experiments were designed to induce flowering and fruiting in the vigorously growing trees.

MATERIAL AND METHODS

The research trial was conducted at Progeny cum Demonstration 'Chausa' mango orchard of Department of

Horticulture, Hamirpur, Himachal Pradesh. The selected orchard was 22 year old, unproductive for the past five years, well fertilized and vigorously growing on a sloppy terrain on the eastern aspect at 900 m amsl. In order to induce flowering and fruiting the following experiments were designed :

Experiment 1: In order to induce flowering and fruiting following treatments were applied to the selected orchard:

Treatment	Deatails
T_1	Foliar application of Ethrel @ 200 ppm, 4 sprays at monthly interval starting from October
T_2	Foliar application of Cycocel @ 125ppm, 4 sprays at monthly interval starting from October
T_3	Foliar application of KNO_3 @ 5%, 4 sprays at monthly interval starting from October
T_4	Foliar application of Paclobutrazol (PBZ) @ 500ppm, in the month of October
T_5	Soil application of NaCl @ 2.5 kg/ tree, two split applications (October and November)
T_6	Soil application of saw dust @3kg/ tree, in the month of July
T_7	Girdling of primary branches
T_8	Girdling of secondary branches
T_9	Control (no treatment)

The experiment was laid in RBD having four replications in each treatment with three trees per replication.

Experiment 2: After the conclusion of first experiment it was found that some of the treatments exerted significant affect on flowering but resulting fruiting was very low. Hence second experiment was laid out in a factorial RBD design with pre-flowering application of growth retardants and post-bloom (fruit set) application of NAA and boric acid.

Factor A: First three treatments of Experiment 1 were taken as the first factor of factorial experiment as per following details:

A_0	No application, only foliar spray of water
A_1	Foliar application of ethrel @ 200 ppm, 4 sprays at monthly interval starting from October
A_2	Foliar application of cycocel @ 125ppm, 4 sprays at monthly interval starting from October
A_3	Foliar application of aclobutrazol @ 500ppm, in the month of October

Factor B: The experimental trees receiving treatments as mentioned under Factor A were given following set of treatments at the time of full bloom:

B_0 No treatment, only foliar spray of water

B_1 Foliar application of boric acid @ 0.5%

B_2 Foliar application of NAA @ 50 ppm

The experiment was laid in RBD having three replications in each treatment with three trees per replication.

In the first experiment conducted for three years (2003-04 to 2005-06), the observations were recorded on date of full bloom, per cent of shoots flowered, number of fruits per panicle at different stages of fruit development, fruit weight, yield and shoot extension growth. The experimental trees were fertilized as per standard recommendations and were kept under uniform orchard management practices. Similarly, in the second experiment the observations were recorded during 2006-07 to 2008-09. The data on full bloom were recorded by taking average date on which more than 70 per cent of the flowers were open on more than 70 per cent panicles. Proportion of flowered shoots was noted by calculating the per cent value of the shoots which flowered per unit volume of the tree in all the four directions. Count of fruit lets and fruits per panicle was taken in the selected tree volume 15 days after fruit set and at harvest. Other parameters were recorded as per standard procedures. The data were analysed as per standard procedures described by Gupta and Kapoor (1991).

RESULTS AND DISCUSSION

Experiment 1

Data on effect of different treatments under Experiment 1 on vegetative and reproductive characteristics are presented in Table 1. It is evident from the data that ethrel and paclobutrazol (PBZ) treatments followed by cycocel, induced earliness in flowering and higher proportion of flowering panicles. Girdling of primary branches also produced better results than control but the impact was not much pronounced. The number of fruit lets per panicle 15 days after full bloom was not influenced significantly by different treatments. It was, therefore, inferred that different treatments though significantly influenced flowering but the consequent effect on fruit set was negligible and the requisite number of fruit lets for yielding good crop was not attained. According to Davenport and Nunez-Elisea (1990 and 1997), 10-15 fruit lets per panicle are required 15 days after fruit set to have good mango crop (this number varied from 6 to 8 under the present studies).

Table 1. Effect of different growth influencing chemicals and practices on vegetative and reproductive aspects of 'Chausa' mango

Treatments	Date of full bloom	Per cent of shoots flowered	No of fruits per panicle (15 days after full bloom)	Average number of fruits per panicle at harvest	Fruit weight (g)	Yield (kg/tree)	Annual shoot extension growth (cm)
T_1	5 April	32.1	8.1	0.04	190	20.0	18.4
T_2	10 April	30.2	8.0	0.05	176	19.8	10.6
T_3	15 April	18.4	6.0	0.06	165	60	15.6
T_4	5 April	36.2	8.0	0.04	188	30.9	10.2
T_5	16 April	12.2	7.0	0.07	172	12.0	16.2
T_6	16 April	20.2	6.0	0.04	170	10.0	14.3
T_7	10 April	27.1	7.0	0.06	175	16.0	16.2
T_8	16 April	10.0	6.0	0.07	169	13.0	15.4
T_9	15 April	10.4	6.2	0.05	168	10.5	14.2
$CD_{0.05}$	-	4.2	NS	NS	10.4	11.2	NS

Further, different treatments also could not influence fruit retention significantly (number of fruits per panicle at the time of harvest). Fruit size was found highest under the ethrel treatment (T_1) but statistically it was at par with PBZ treatment (T_4). Higher fruit weight under these treatments may be attributed to the earliness in flowering which provided higher number of growing days and biomass accumulation in the fruits under these treatments. The yield per tree obtained was highest with PBZ treatment (T_4) and it was at par with ethrel (T_1) and cycocel (T_2) treatments that may be attributed to the higher proportion of shoots which flowered under these treatments in comparison to the other treatments.

Experiment 2

The data on observations of Experiment 2 are presented in Table 2. It is evident from the data that the effect of

Table 2. Effect of pre- and post-bloom treatments on induction of fruiting in unproductive 'Chausa' mango orchards

SA	No of fruit lets per panicle 15 days after fruit set				No of fruits per panicle at harvest				Fruit weight (g)				Yield (kg/tree)				Shoot extension growth (cm)			
	B_0	B_1	B_2	Mean	B_0	B_1	B_2	Mean	B_0	B_1	B_2	Mean	B_0	B_1	B_2	Mean	B_0	B_1	B_2	Mean
A_0	5.2	9.3	7.2	7.2	0.06	0.13	0.11	0.10	165	180	170	172	10.2	24.0	20.4	18.2	15.6	16.4	18.6	16.9
A_1	9.5	12.0	13.0	11.5	0.19	0.20	0.17	0.19	182	185	178	182	14.2	37.2	46.7	32.7	11.2	11.2	12.6	11.7
A_2	8.7	12.2	11.2	10.7	0.19	0.29	0.09	0.19	176	180	172	176	17.6	42.4	39.3	33.1	10.4	12.8	14.4	12.5
A_3	9.5	13.8	11.2	11.5	0.20	0.31	0.11	0.21	190	200	180	190	20.4	58.2	48.0	42.2	9.2	11.0	11.2	10.5
Mean	8.2	11.9	10.7		0.16	0.23	0.12		178	186	175		15.6	40.5	38.6		11.6	12.9	14.2	
$CD_{0.05}$ for A				4.1				NS				11.4				14.6				NS
$CD_{0.05}$ for B				2.3				NS				NS				17.1				2.5
$CD_{0.05}$ for A*B				1.9				0.10				17.4				15.4				NS

different treatments under Factor A (pre-bloom treatments) was found significant as far as number of fruit lets per panicle or fruit weight or shoot extension growth was concerned. But this effect was significantly different only to no spray treatment (A_0); other treatments being at par in the effect. Influence of Factor B treatments was found significant only in case of number of fruit lets, yield and shoot extension growth. Treatments other than no spray treatment (B_0) were found statistically at par in almost all the cases. Interaction effects were quite pronounced and it was found that highest number of fruit lets per panicle, number of fruits at harvest, fruit weight and yield were recorded highest with treatment combination A_3B_1 ie paclobutrazol and boric acid. Statistically, these were at par with A_1B_2 (ethrel and NAA treatment combination) in case of number of fruit lets per panicle and yield. These were also at par with A_1B_1 (ethrel and boric acid treatment combination) in case of number of fruitlets per panicle and fruit weight but, yield obtained was superior in A_3B_1 than in A_1B_1. It is clear from the results that interaction effects were more pronounced and clear than the individual factorial treatments.

The above results show that foliar application of paclobutrazol @ 500 ppm in the month of October followed by boric acid spray at fruit set was found to be the best treatment for induction of flowering and fruiting in 'Chausa' mango. Cycocel and boric acid treatment was found to be the second best treatment followed by ethrel and NAA application. Foliar application of PBZ, uniconazole and cycocel to stimulate enhanced and early flowering under sub optimal temperature conditions has also been speculated by Nunez – Elisea et al 1993. Independent effect of boric acid and NAA has also been described by a number of workers (Vasil 1963, Agarwala et al 1981, Robbertse et al 1990, Khan et al 1993). Better results of ethrel when combined with NAA at fruit set can be better understood with the views of Roberts and Osborne (1981) who established that protection of abscission zone in ethylene induced flowering is dependent upon a constant supply of auxins. If endogenous level of auxins under such conditions goes low for any reason it leads to extensive fruit let drop. Thus the application of NAA at fruit set to ethrel treated trees produced better results. This treatment alongwith cycocel plus NAA maintained better balance between vegetative and reproductive growth.

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REFERENCES

Anonymous 2007. Horticultural Statistics. Department of Horticulture, Himachal Pradesh.

Agarwala SC, Sharma PN, Chatterjee C and Sharma PC 1981. Development and enzymatic changes

during pollen development of boron deficient maize. Journal of Plant Nutrition **3**: 329 – 336.

Davenport TL and Nunez–Elisea R 1990. Ethylene and other endogenous factors possibly involved in mango flowering. Acta Horticulturae **275**: 441-448.

Davenport TL and Nunez–Elisea R 1997. Reproduction Physiology. In: The mango, botany, production and uses. Ed RE Litz, CAB International, 69-146 pp.

Gupta SC and Kapoor VK 1991. Fundamentals of mathematical statistics. Sultna Chand and Sons, New Dehli, 580p.

Khan MA, Malik AB, Makhdoom ML and Haq A 1993. Investigations on the efficiency of exogenous synthetic growth regulators and fruit drop in mango. Egyptian Journal of Horticulture **20**: 1-14.

Nunez-Elisea R, Davenport TL and Calderia ML 1993. Bud initiation and morphogenesis in 'Tommy Atkins' mango as affect by temperature and triazole growth retardants. Acta Horticulturae **341**: 192-198.

Robbertse PJ, De Wet E and Coetzer LA 1990. The influence of boron application on fruit set and yield of mangos. South African Mango Growers' Association Yearbook **10**: 24-27.

Roberts JA and Osborne DJ 1981. Auxins and the control of ethylene production during the development and senescence of leaves and fruits. Journal of Experimental Botany **32**: 875–889.

Vasil IK 1963. Effect of boron on pollen germination and pollen tube growth. In: Linskens, H. F. (ed.) Pollen Physiology and Fertilization. North Holland, Amsterdam, pp 107-119.

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