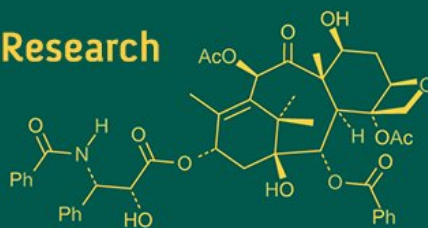


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Effect of soil drenching of paclobutrazol on flowering yield and quality of mango cv kesar

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Abstract

A field experiment was conducted during 2025-26 at the Regional Fruit Research Station, Katol, Vidarbha region of Maharashtra, on twenty-six-year-old bearing trees of mango cv. Kesar to study the effect of concentration and time of soil application of paclobutrazol (PBZ) on vegetative growth, flowering, fruit set, yield and fruit quality. Five concentrations of PBZ (2.0, 2.5, 3.0, 3.5 and 4.0 g m⁻¹ canopy diameter) were applied as soil drench with four dates of application (3rd week of August, 1st week of September, 3rd week of September and 1st week of October) in twenty combinations under Factorial Randomized Block Design with three replications. Vegetative growth (number and length of new shoots) declined progressively with increasing PBZ concentration, irrespective of application time. The moderate concentration of 2.5 g m⁻¹ (P2), applied in the third week of August (T1), significantly hastened flower bud initiation, 50 per cent flowering, full bloom and fruit maturity, and gave the highest fruit retention, lowest fruit drop, maximum fruits per tree (396.99) and highest yield (87.66 kg tree⁻¹; 8.76 t ha⁻¹). The concentration × time interaction was significant for fruits per tree and yield, the advantage of P2 being greatest when combined with T1. Soil drenching of paclobutrazol at 2.5 g m⁻¹ canopy diameter during the third week of August is recommended as the most suitable treatment for hastening flowering and maturity and for improving yield of mango cv. Kesar under Vidarbha conditions.

Keywords: Mango; kesar; paclobutrazol; soil drenching; flowering; fruit yield

Introduction

Mango (*Mangifera indica* L.), popularly known as the “King of Fruits,” is one of the most important fruit crops of India. Among the commercial cultivars, Kesar is highly preferred for its attractive fruit colour, pleasant flavour, good eating quality and consumer demand. However, irregular flowering, excessive vegetative growth, poor fruit retention and variation in yield are some of the major constraints in mango production. Paclobutrazol (PBZ), a plant growth retardant, is widely used in mango for regulating vegetative growth and promoting flowering. It inhibits gibberellin biosynthesis, thereby restricting excessive shoot growth and favouring reproductive development. The response of PBZ depends considerably on the concentration applied, time of application, tree age, canopy size and prevailing environmental conditions. Hence, proper selection of dose and application time is important for obtaining desirable flowering and yield without adversely affecting fruit quality. Although the effectiveness of PBZ has been reported in several mango cultivars, its response under specific agro-climatic conditions and particularly in mature Kesar trees may vary. Therefore, the present investigation entitled “Effect of soil drenching of Paclobutrazol on flowering, yield and quality of mango cv. Kesar” was undertaken to evaluate different concentrations and times of soil application and to identify a suitable treatment for improving flowering, productivity and fruit quality of Kesar mango.

Materials and Methods

The experiment was conducted during the year 2025-26 at Regional Fruit Research Station in Katol, Maharashtra, to evaluate the effect of soil drenching of paclobutrazol on growth, flowering, fruiting, yield and quality of mango cv. Kesar. The experiment was laid out in a factorial randomized block design (FRBD) comprising twenty treatment combinations with

three replications. The experiment was conducted on uniform, 26-year-old Kesar mango trees. Paclobutrazol 23% SC was applied through soil drenching at five concentrations viz., 2.0, 2.5, 3.0, 3.5 and 4.0 g⁻¹ of canopy diameter, at four different times, viz., third week of August, first week of September, third week of September and first week of October. The required quantity of paclobutrazol was applied around the tree basin near the active root zone. Twenty terminals were randomly selected and tagged on each experimental tree, with five terminals representing each direction, for recording observations on vegetative growth and flowering behaviour. Observations on new shoots, shoot length, number of shoots, days to flowering, panicle length, flowering percentage, fruit set, fruit drop, yield and fruit quality attributes were recorded. Standard recommended orchard management practices, including irrigation, nutrient management, weed control and plant protection, were followed throughout the experimental period. The recorded data were statistically analysed as per the procedure described by Panse and Sukhatme (1967) [11].

Results and Discussion

Effect of paclobutrazol concentration

Vegetative growth parameters

Increasing the concentration of paclobutrazol (PBZ) from 2.0 to 4.0 g m⁻¹ canopy diameter steadily reduced vegetative vigour in mango cv. Kesar. Trees receiving the lowest dose, 2.0 g m⁻¹ (P₁), produced the newest shoots per terminal (1.59) and the longest shoots (15.22 cm), while the highest dose, 4.0 g m⁻¹ (P₅), gave the fewest shoots (1.30) and the shortest growth (10.70 cm). This dose-dependent decline fits the known mode of action of paclobutrazol, which blocks ent-kaurene oxidase in the gibberellin biosynthesis pathway and thereby restricts sub-apical meristematic activity and cell elongation. A comparable suppression of shoot length and leaf area with rising PBZ concentration has been reported by Sahoo *et al.* (2022) [15], and Kishore *et al.* (2015) [8], while Kulkarni (1988) [9], similarly described the chemical control of vegetative vigour as a consistent feature of growth-retardant use in mango, reinforcing that vegetative restriction is a near-universal, dose-driven response irrespective of cultivar.

Flowering parameters

PBZ concentration also had a clear effect on the timing of flowering. The moderate dose of 2.5 g m⁻¹ (P₂) advanced flowering the most, with bud initiation at 48.61 days, 50 per cent flowering at 63.20 days and full bloom at 76.93 days, whereas the higher doses (P₄ and P₅) delayed these stages considerably, full bloom under 4.0 g m⁻¹ being pushed back to 84.89 days. This pattern is consistent with the physiological role of PBZ: at moderate concentrations it shifts the hormonal balance in the apical bud by suppressing vegetative gibberellins while allowing abscisic acid and cytokinin to accumulate, favouring prompt floral induction, whereas very high doses appear to tip into mild phytotoxic stress that delays rather than hastens bud differentiation. Upreti *et al.* (2013) [20], and Sarker and Rahim (2018) [16], reported a similar hormonal basis for early flowering under optimal PBZ doses in mango, and Singh *et al.* (2021) likewise linked the flowering response to concentration-dependent regulation of gibberellin synthesis, lending further support

to the trend observed here.

Fruit set, fruit retention and fruit drop

Fruit set and retention followed the same optimum at P₂ (2.5 g m⁻¹), which recorded the highest fruit set at both the pea stage (10.38% fruits shoot⁻¹) and the marble stage (3.86% fruits shoot⁻¹), the best fruit retention (44.47%) and the lowest fruit drop (55.53%). The heaviest dose, P₅ (4.0 g m⁻¹), reversed this advantage, raising fruit drop to 66.17 % and lowering retention to 33.83 %. A likely explanation is that by curbing excessive vegetative flushing, moderate PBZ doses reduce competition between shoots and developing fruitlets for photosynthates, delaying the onset of the abscission layer during early fruit development, a pattern also described by Burondkar and Gunjate (1993) [1], and Yeshitela *et al.* (2004) in their work on paclobutrazol-treated mango.

yield parameters

These trends in fruit set and retention carried through directly to yield: P₂ (2.5 g m⁻¹) again performed best, with the highest number of fruits per tree (396.99), the highest fruit yield per tree (87.66 kg) and the highest total productivity (8.76 t ha⁻¹), while the heaviest dose, P₅, brought yield down to 72.16 kg/tree. This is best explained by a more favourable sink-source balance at moderate PBZ concentrations, which channels a larger share of assimilates into reproductive growth rather than vegetative expansion, raising overall crop load. Similar concentration-dependent yield responses have been documented by Vijayalakshmi and Srinivasan (2000) and Singh and Bhattacharjee (2005) [18], in Alphonso mango, and more recently by Gohel and Malam (2021) [4], Chavan (2023) [3], and Reddy *et al.* (2014) [14], in Kesar and Alphonso mango under comparable soil-drenching schedules, which strengthens confidence that 2.5 g m⁻¹ represents a genuine dose optimum rather than a result specific to this trial.

Effect of time of application

Vegetative growth parameters

Unlike concentration, the timing of application (T₁ to T₄) had no significant effect on either shoot count or shoot length. Within the August-to-October window used in this trial, vegetative growth suppression in mango therefore appears to be governed chiefly by the intensity of the chemical dose rather than by exactly when it is applied, a conclusion also reached by Kurian and Iyer (1993) in their study of growth-retardant effects in mango.

Flowering parameter

Time of application, however, did matter for flowering. Trees drenched earliest, in the third week of August (T₁), reached bud initiation soonest (49.70 days), followed by 50 per cent flowering at 65.21 days and full bloom at 78.36 days, while the latest treatment, the first week of October (T₄), lagged at every stage, taking 55.67, 72.97 and 82.77 days respectively. The most likely reason is that an August application gives the tree enough lead time for gibberellin levels to decline and carbohydrates to build up in the terminal shoots before the natural window for floral differentiation, a sequence also noted by Burondkar *et al.* (2000) and, specifically for Kesar mango, by Petkule *et al.* (2024) [12].

Table 1: Effect of dose of paclobutrazol at different time of on vegetative growth, flowering and fruiting in mango cv. Kesar

Treatments	No. of new shoots terminal ⁻¹	Length of new shoot terminal ⁻¹ (cm)	Days to flower bud initiation	Days to 50% flowering	Days to full bloom	No. of fruits shoot ⁻¹ at pea stage(%)	No. of fruits shoot ⁻¹ at marble stage(%)
A) Concentration of paclobutrazol (g m⁻¹ canopy diameter)							
P1 - 2.0	1.59	15.22	50.05	65.07	78.22	9.97	3.37
P2 - 2.5	1.52	14.13	48.61	63.20	76.93	10.38	3.86
P3 - 3.0	1.46	13.10	52.25	67.92	80.90	9.67	3.36
P4 - 3.5	1.35	12.10	55.90	72.68	82.80	9.61	3.17
P5 - 4.0	1.30	10.70	56.55	76.52	84.89	8.90	3.06
F test	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.02	0.18	0.84	1.10	1.20	0.18	0.05
CD at 5%	0.07	0.54	2.42	3.15	3.44	0.52	0.16
B) Time of application							
T1 - 3rd wk Aug	1.42	12.94	49.70	65.21	78.36	10.34	3.55
T2 - 1st wk Sep	1.44	13.02	51.55	67.62	79.16	9.85	3.40
T3 - 3rd wk Sep	1.46	13.24	53.78	70.51	81.10	9.52	3.31
T4 - 1st wk Oct	1.46	13.00	55.67	72.97	82.77	9.11	3.20
F test	NS	NS	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.02	0.16	0.75	0.98	1.07	0.16	0.05
CD at 5%	-	-	2.16	2.81	3.08	0.46	0.14
C) Interaction (Conc. × Time)							
F test	NS	NS	NS	NS	NS	NS	NS
SE(m)±	0.06	0.46	2.07	2.69	2.94	0.44	0.14
CD at 5%	-	-				-	-

Table 2: Effect of dose of paclobutrazol at different time of on fruiting and yield in mango cv. Kesar

Treatments	Fruit retention shoot ⁻¹ (%)	Fruit drop shoot ⁻¹ (%)	Days taken to fruit maturity	Number of fruits per tree	Fruit yield (kg/tree)	Fruit yield (t/ha)
A) Concentration of paclobutrazol (g m⁻¹ canopy diameter)						
P1 - 2.0	40.04	59.96	195.55	184.56	83.74	8.74
P2 - 2.5	44.47	55.53	192.32	192.14	87.66	8.76
P3 - 3.0	38.92	61.08	202.21	173.23	78.76	7.87
P4 - 3.5	36.04	63.96	207.00	167.51	75.91	7.59
P5 - 4.0	33.83	66.17	207.24	159.09	72.16	7.21
F test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.64	0.86	3.01	3.73	1.35	0.13
CD at 5%	1.83	2.48	8.61	10.68	3.88	0.38
B) Time of application						
T1 - 3rd wk Aug	40.67	56.56	195.90	196.34	90.10	9.09
T2 - 1st wk Sep	39.09	57.87	197.90	177.71	80.94	8.09
T3 - 3rd wk Sep	38.02	57.10	202.75	168.46	76.05	7.60
T4 - 1st wk Oct	36.86	60.29	206.92	158.72	71.49	7.14
F test	Sig	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.57	0.77	2.69	3.33	1.21	0.12
CD at 5%	1.64	2.22	7.70	9.55	3.47	0.34
C) Interaction (Conc. × Time)						
F test	NS	NS	NS	Sig	Sig	Sig
SE(m)±	1.57	2.12	7.37	9.14	3.32	0.33
CD at 5%				26.17	9.52	0.95

Flowering parameter

Time of application, however, did matter for flowering. Trees drenched earliest, in the third week of August (T₁), reached bud initiation soonest (49.70 days), followed by 50 per cent flowering at 65.21 days and full bloom at 78.36 days, while the latest treatment, the first week of October (T₄), lagged at every stage, taking 55.67, 72.97 and 82.77 days respectively. The most likely reason is that an August application gives the tree enough lead time for gibberellin levels to decline and carbohydrates to build up in the terminal shoots before the natural window for floral differentiation, a sequence also noted by Burondkar *et al.* (2000) and, specifically for Kesar mango, by Petkule *et al.* (2024) [12].

Fruit Set, Retention, and Drop Parameters

The same early-application advantage carried through to fruit set and retention. T₁ (third week of August) again led, with the highest fruit set at the pea stage (10.34 fruits shoot⁻¹) and marble stage (3.55 fruits shoot⁻¹), the best retention (40.67%) and the lowest drop (56.56%), whereas T₄ (first week of October) trailed on every count, retention falling to 36.86 per cent and drop rising to 60.29 per cent. Applying PBZ early appears to align the hormonal shift it induces with the tree's natural flower bud initiation cycle, an interpretation consistent with Yeshitela *et al.* (2004) and, for Kesar mango in particular, with Petkule *et al.* (2024) [12].

Yield parameters

Yield followed the same downward trend from T₁ to T₄. The earliest application, T₁, gave the most fruits tree⁻¹ (399.00), the highest yield tree⁻¹ (90.10 kg) and the highest total yield (9.09 t ha⁻¹), while T₄ recorded the lowest values across the board: 311.58 fruits per tree, 71.49 kg tree⁻¹ and 7.14 t ha⁻¹. Early application evidently supports both greater floral intensity and better fruit retention, and together these translate into higher final yield, a relationship also reported by Singh and Bhattacharjee (2005) [18]. and, for Kesar mango specifically, by Jadhav *et al.* (2026) [6]. and Reddy and Kurian (2008) [13].

Interaction effect

The concentration of PBZ × time of application interaction was statistically significant for yield tree⁻¹ and total yield.

By far the best combination was 2.5 g m⁻¹ PBZ applied in the third week of August (P₂T₁), which produced the greatest fruit load and productivity (CD at 5% = 26.17 for fruit count, 9.52 kg/tree and 0.95 t ha⁻¹). Pairing a high chemical dose with a delayed application, by contrast, seemed to work against the tree's natural phenology, and these combinations gave the poorest yields recorded in the trial. Chavan (2023) [3], studying the interaction between PBZ dose and time of application in Kesar mango specifically, reported a closely comparable synergy at moderate doses applied early in the season, as did Burondkar *et al.* (2000) and Gohel and Malam (2021) [4], together indicating that the P₂T₁ combination identified here reflects a genuine agronomic optimum rather than an artefact of this particular trial.

Table 3: Interaction effect of dose of paclobutrazol and time of application on the yield in mango cv. Kesar

Treatment	Number of fruits tree ⁻¹	Fruit yield (kg tree ⁻¹)	Fruit yield (t ha ⁻¹)
P ₁ T ₁	208.97	96.47	9.64
P ₁ T ₂	183.46	86.35	8.63
P ₁ T ₃	183.44	78.21	7.82
P ₁ T ₄	177.42	73.94	7.39
P ₂ T ₁	218.02	97.45	9.74
P ₂ T ₂	192.62	89.09	8.9
P ₂ T ₃	186.03	85.47	8.54
P ₂ T ₄	181.04	78.64	7.86
P ₃ T ₁	194.62	91.07	9.1
P ₃ T ₂	176.91	78.32	7.83
P ₃ T ₃	165.77	74.31	7.43
P ₃ T ₄	150.42	71.32	7.13
P ₄ T ₁	181.53	85.71	8.57
P ₄ T ₂	172.33	76.67	7.66
P ₄ T ₃	159.24	72.94	7.29
P ₄ T ₄	146.79	68.32	6.83
P ₅ T ₁	178.55	79.82	7.98
P ₅ T ₂	163.20	74.28	7.42
P ₅ T ₃	147.80	69.32	6.93
P ₅ T ₄	137.94	65.27	6.52
F' test	Sig	Sig	Sig
SE (m) ±	9.14	2.48	0.24
CD at 5%	26.17	7.11	0.71

Conclusion

Vegetative growth of mango cv. Kesar was progressively suppressed with increasing PBZ concentration, irrespective of application time. Soil drenching of PBZ at 2.5 g m⁻¹ canopy diameter during the third week of August was the most effective treatment, hastening flowering and maturity and giving the highest fruit retention, yield. This treatment is recommended for mango cv. Kesar under Vidarbha conditions, though the trial should be repeated for at least one more season, with residual soil analysis, before a firm field recommendation.

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