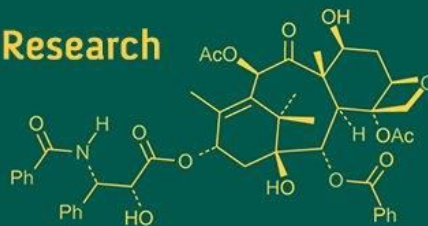
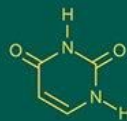
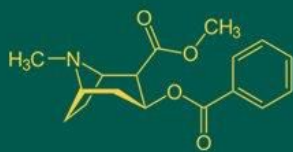


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Effect of the chemicals on early ambia bahar in acid lime (*Citrus aurantifolia* Swingle)

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Abstract

A field trial was conducted during 2024-2025 at the Sweet Orange Research Station, Badnapur to study the effect of chemicals and growth retardants on ambia bahar flowering in acid lime cv. Sai Shrabati. The experiment, laid out in RBD with nine treatments and three replications, revealed that soil drenching of paclobutrazol @ 2.5 ml/canopy diameter (T_6) was significantly superior. It induced earliest flowering (39.67 days), highest fruit set (48%), maximum yield (1274 fruits/tree), and improved fruit quality with higher TSS (8.23%), acidity (5.88%), and shelf life (18.67 days). Urea @ 5% foliar spray enhanced vegetative growth and juice recovery, while ethrel @ 1500 ppm increased foliation and vitamin C. Overall, paclobutrazol soil drenching @ 2.5 ml per canopy diameter is highly effective for advancing flowering, increasing yield, and enhancing fruit quality in early ambia bahar acid lime cultivation.

Keywords: Acid lime, Ambia bahar, Chemicals

Introduction

One of the most widely grown fruit crops in India's tropical and subtropical regions is acid lime (*Citrus aurantifolia* Swingle). It belongs to the Rutaceae family. The most widely cultivated cultivar is the kagzi lime.

The world's largest producer of acid limes (*Citrus aurantifolia* Swingle), a citrus fruit with substantial market value, is India. Global output of lemons and limes is estimated by the USD (2024) to be 10.2 million tons, with tropical and subtropical regions producing the majority of this total. India produces about 2.54 million tonnes of acid lime annually on an estimated 282,000 hectares of acid lime, with an average productivity of 9.0 tonnes/ha (Anonymous, 2024) [1]. The citrus crop occupies almost 10 percent of the country's total growing area. Maharashtra are the principal Indian states that cultivate acid lime. More than 10% of India's citrus-growing land is used for the production of acid lime.

Due to higher demand in April and May, summer-harvested Hasta bahar fruits command the highest market prices. However, because of the monsoon rains that come before, flowering is frequently repressed during this season. Crop control is therefore necessary to optimize fruit Due quality and output by coordinating flowering with favorable market times. To encourage synchronized and abundant flowering, methods like water restriction, trimming, and the use of growth regulators like ethylene, urea, and paclobutrazol are frequently employed (Mandloi *et al.*, 2021).

One of the best methods for controlling acid lime flowering is the use of plant growth retardants (PGRs) and chemical treatments such as urea, paclobutrazol, and ethrel. When ethrel (ethephon) is sprayed on leaves at 500-1000 parts per million, it releases ethylene, which stimulates bud activation, stress induction, and leaf shedding, resulting in consistent flowering following defoliation (Reddy). Similar to this, urea at concentrations of 15-20% functions as a chemical defoliant, producing regulated stress that promotes flower bud differentiation over vegetative shoots (Gowda). An inhibitor of gibberellin production, paclobutrazol, is available as a soil drench (5-10 ml/tree) or foliar spray (100-200 ppm). It increases floral induction and improves fruit quality by limiting vegetative growth and encouraging the buildup of cytokinins and sugars.

Materials and Methods

The investigation were executed at Sweet Orange Research Station, Badnapur during year 2025 under Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani with nine treatments viz, T₁ Ethrel- 1500 ppm (Foliar spray), T₂ Ethrel- 2000 ppm (Foliar spray), T₃ Urea- 4% (Foliar spray), T₄ Urea - 5% (Foliar spray), T₅ Paclobutrazol- 2 ml/per canopy diameter (Soil drenching), T₆ Paclobutrazol- 2.5 ml/per canopy diameter (Soil drenching), T₇ Paclobutrazol- 500 ppm (Foliar spray), T₈ Paclobutrazol- 750 ppm (Foliar spray) and T₉ Control with 3 replications. The result indicates that treatment T₆ 2.5 ml paclobutrazol reduced flower drop to 52% (vs. 83.3% in control).

Spraying of ethrel during the month of October, with holding irrigation (Bahar) for 30 days in September followed by application of recommended dose of fertilizers and irrigation in the month of November and along with control (Not spray). The experiment was laid out in a randomized block design with three replications. The effect of different treatments was studied on flower parameters (no of days for initiation of flowering, total no of flowers fruit set percent yield attributes like number of fruits per tree, fruit weight on five randomly selected trees. The mean data were subjected to statistical analysis following analysis of variance technique (Panse and Sukhathme 1985)^[8].

Results and discussion

Days required for initiation of flowering

The earliest flowering was recorded in treatment T₆ soil drenching of paclobutrazol @ 2.5 ml which took (39.67) days to initiate flowering. This was found to be at par with T₅ soil drenching of paclobutrazol @ 2 ml which took (40.17) days, T₂ ethrel @ 1500 ppm (41.00) days, T₁ foliar spray of ethrel @ 1500 ppm (41.50) days which treatment demonstrated early flowering induction in acid lime. After that treatment T₈ Foliar spray paclobutrazol- 500 ppm of requires (44.67) days which was significantly at par with T₇ foliar spray paclobutrazol- 500 ppm Foliar spray (45.50) days, T₃ Foliar spray of urea @ 4% (46.00) days and T₄ foliar spray of urea @ 5% (46.50). All the treatment shows early flowering as compared to T₉ control required (60.00) days to the flowering. Similar results found were by Ingale *et al.*, (2010)^[5] in acid lime by application of paclobutrazol and Gohel *et al.* (2021)^[4] reported that paclobutrazol application i.e., 5, 8.5, 11.5 and 14.5g a.i. revealed significantly minimum days to initiation of flowering.

Total no of flowers

Highest total no. of flowers was recorded in acid with treatment T₆ soil drenching of paclobutrazol @ 2.5 ml (1901) flowers per tree which was significantly superior treatment which was at par with T₅ soil drenching of paclobutrazol @ 2 ml (1855.50) flowers, T₂ foliar spray of ethrel- 1500 ppm (1884) flowers, T₁ ethrel- 1500 ppm (1880.29) flowers and T₄ Foliar spray of urea @ 5% (1874) flowers. Intermediate effect was showed by treatment T₃ foliar spray of urea @ 4% (1823), no of flowers per tree which was significantly at par with T₈ foliar spray paclobutrazol @ 750 ppm foliar spray (1799) total no of flowers per tree, T₇ foliar spray paclobutrazol @ 500 ppm Foliar spray (1776) flowers per tree. All the treatment shows a greater number of flowers as compare to T₉ control required (1700) flowers per tree. Similar findings were by found Bagel *et al.* (2004)^[2] reported that maximum number of flowers per shoot in mango after paclobutrazol applied 5

g/tree paclobutrazol, Ashok *et al.* (2021) The study demonstrated paclobutrazol's role in promoting flowering and enhancing fruit quality.

Fruit set per cent (%)

The maximum fruit set is observed significantly superior with treatment T₆ soil drenching of paclobutrazol @ 2.5 ml (48.00) fruit set which was at par with treatment T₅ soil drenching of paclobutrazol @ 2 ml results (47.00) per cent fruit set, T₂ foliar spray of ethrel- 2000 ppm results show (46.00) per cent fruit set and T₁ ethrel- 1500 ppm (45.50). while, the lowest fruit set (%) observed under treatment T₉ (control) (16.67) in acid lime.

Similar results were reported by Kulkarni (1988), who observed that an increase in the number of flowers ultimately led to a higher sex ratio. Paclobutrazol was found to promote flowering in mango by inhibiting gibberellin biosynthesis and altering the hormonal balance. Similarly, Patel *et al.* (2015)^[9] reported that paclobutrazol enhanced flowering and fruit set in acid lime.

Number of fruits per tree

The maximum number of fruits per tree was observed under significantly superior treatment T₆ soil drenching of paclobutrazol @ 2.5 ml (1274.00) fruits per tree. which was at par with treatment T₅ soil drenching of paclobutrazol @ 2 ml (1264.00) fruits per tree, T₂ foliar spray of ethrel- 2000 ppm results show (1257.00) fruits per tree and T₁ ethrel- 1500 ppm (1237.00) number of fruits per tree, while all the treatment shows a greater number of fruits per tree as compare normal hasta /early ambia bahar compared to T₉ control results show (1000) fruits in acid lime.

The increased number of fruits per plant under treatment T₃ could be attributed to the growth-retarding effect of paclobutrazol, which enhances carbohydrate accumulation in leaves, promoting flowering and fruit set. It also improves assimilate partitioning towards developing fruits, Similar result found by Tandel and Patel (2011)^[4]. Their study revealed that paclobutrazol enhanced fruit set, improved fruit retention, and contributed to a higher yield by regulating vegetative growth and promoting reproductive development.

Fruit weight (g)

The maximum fruit weight was recorded under the significantly superior treatment T₆ which was, i.e soil drenching with paclobutrazol @ 2.5 ml per canopy diameter, which recorded fruit weight (52.00 gm). This was statistically at par with T₅ paclobutrazol @ 2 ml per canopy diameter recorded (51.50 gm), T₂ foliar spray of @ 2000 ppm (50.50 gm), T₁ foliar spray of @ 1500 ppm in acid lime (50.00 gm), T₈ foliar spray of paclobutrazol @ 750 ppm, which recorded 48.00 gm fruit weight. And T₇ foliar spray of paclobutrazol foliar spray @ 500 ppm 47.00 gm which shows borderline effect with significantly superior treatment. These treatments showed significant difference in increasing fruit weight in acid lime. Result shows parallelism to the findings of (Baskaran and Sathiamurthy, 2008)^[3]. In mango, paclobutrazol generally increased fruit weight by reducing vegetative growth and enhancing assimilate translocation towards fruits (Reddy and Kurian,). Overall, paclobutrazol tends to enhance fruit weight by modulating growth and resource allocation though effects vary by species and application method.

Treatment	Treatment Details	Days required for initiation of flowering	Total no. of flowers	Fruit set (%)	No of fruits per tree	Fruit weight (gm)
T ₁	Ethrel- 1500 ppm (Foliar spray)	41.50	1880.29	45.50	1237.00	50.00
T ₂	Ethrel- 2000 ppm (Foliar spray)	41.00	1884.37	46.00	1257.00	50.50
T ₃	Urea- 4% (Foliar spray)	46.00	1823.33	43.23	1192.67	45.00
T ₄	Urea- 5% (Foliar spray)	46.50	1873.30	44.00	1206.00	46.00
T ₅	Paclobutrazol- 2 ml/per canopy diameter (Soil drenching)	40.17	1885.50	47.00	1264.00	51.50
T ₆	Paclobutrazol- 2.5 ml/per canopy diameter (Soil drenching)	39.67	1901.00	48.00	1274.00	52.00
T ₇	Paclobutrazol- 500 ppm (Foliar spray)	45.50	1776.67	42.50	1155.00	47.00
T ₈	Paclobutrazol- 750 ppm (Foliar spray)	44.67	1799.00	42.67	1163.33	48.00
T ₉	Control	60.00	1700.00	16.67	1000.00	30.00
	S.E (m) $\pm$	0.80	18.18	0.93	34.07	1.72
	C.D at 5%	2.44	52.86	2.69	105.15	5.00

Conclusion

The study confirms that soil drenching with paclobutrazol at 2.5 ml per canopy diameter is the most effective treatment for promoting early flowering, increasing flower production, enhancing fruit set, and improving yield and fruit quality in acid lime. The findings align with earlier reports indicating that paclobutrazol's growth-retarding effect and influence on hormonal balance significantly boost reproductive development.

Thus, the application of paclobutrazol can be recommended as an efficient crop regulation technique for achieving higher productivity and better-quality fruits in acid lime cultivation under field conditions.

References

- Anonymous. Area production of horticulture crops in India. Indian Horticulture Database. National Horticulture Board; 2024.
- Bagel BS, Singh CP, Singh S. Effect of paclobutrazol on flowering and fruit set in mango (*Mangifera indica* L.) cv. Langra. J Appl Hortic. 2004;6(2):73-76.
- Baskaran A, Sathiamurthy S. Effect of growth retardants on quality of papaya (*Carica papaya* Linn.) cv. CO-2. Asian J Hortic. 2008;3(2):313-314.
- Gohel BC, Malam VR, Mishra S, Solanki M, Patel VS. Effect of soil-applied paclobutrazol at different time on growth and flowering of mango (*Mangifera indica* L.) cv. Kesar. Pharma J. 2021;10(10):293-457.
- Ingale VD, et al. Effect of paclobutrazol on flowering and fruit quality in acid lime. [PhD thesis]. Dharwad: University of Agricultural Sciences; 2010.
- Kulkarni HF. Paclobutrazol promotes flowering in mango by inhibiting gibberellin and altering hormonal balance. In: Proc Natl Symp Plant Growth Substances. 1988. p. 112-117.
- Meena R, Yadav PK, Singh RS. Response of date palm cultivars to varying concentration of ethephon on yield and yield-attributing characters. Prog Agric. 2013;13(1):1-3.
- Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 3rd rev ed. New Delhi: Indian Council of Agricultural Research; 1985.
- Patel VS, Sheth HK, Patel BB. Paclobutrazol enhances flowering and fruit set in acid lime. Indian J Hortic. 2015;72(3):431-435.
- Tandel V, Patel V. Effect of paclobutrazol on growth and flowering of mango (*Mangifera indica* L.) cv. Kesar. J Hortic Sci. 2011;6(2):100-105.