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Evaluation of different methods of defoliation in lasora (*Cordia myxa* L.) under semi-arid conditions of western India

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ABSTRACT

Lasora commonly known as Indian cherry, is a potential yet underutilized fruit tree of arid and semi-arid climates and shows strong potential for commercial use in the vegetable and pickle industry. The present study aimed at obtaining a high yield and good quality fruits of lasora by using defoliation agents. Defoliation in the months of December to January is required for early fruiting, fetching good market price as well as maximum production of lasora. The defoliation practices and dormancybreaking chemicals influence phenology, yield and fruit quality in lasora. Manual defoliation served as an effective method to trigger defoliation. Chemical combinations, particularly thiourea (TU), ethephon and diammonium phosphate (DAP), also induced substantial leaf abscission through enhanced ethylene action, while 2,4-D was less effective. These same treatments accelerated sprouting and flower initiation compared with untreated control plants; TU's dormancybreaking effect likely stems from increased cellular starch and altered protein composition, thereby raising the C:N ratio. In contrast, 2,4-D delayed bud break and flowering. Early sprouting led to earlier flowering and fruit maturation, conferring commercial advantages by allowing earlier market availability. Maturity occurred around 55–57 days after defoliation with Thiourea 10 g + ethephon 4 ml + DAP 10 g litr^{-1} treatment and ethephon (4 ml litr^{-1}) alone, whereas 2,4-D and control treatments required about 64 days. Fruit set improved markedly, reaching nearly 21 % with the chemical combination. Fruit weight rose to approximately 8 g compared with 6.39 g in controls. Yield per plant and per hectare doubled under treatment (T_5) Thiourea 10 g + ethephon 4 ml + DAP 10 g litr-^{1}; manual defoliation also significantly increased yield. Fruit quality was enhanced: total soluble solids exceeded 13 %, and the stone:flesh ratio declined to 0.14 or less, indicating a higher pulp content. Although DAP's specific role is unclear, it may contribute nitrogen that supports growth and yield. Overall, strategic defoliation particularly the combination of manual leaf removal with thiourea and ethephon proved effective for modulating phenology, boosting yield and improving fruit quality in lasora.

Key words: Indian cherry, dormancy breaking, defoliation agents, semi-arid, fresh quality.

INTRODUCTION

The western Indian states of Rajasthan and Gujarat contain about 81% of the Indian Thar Desert and others states like Punjab and Haryana makes up 89.6% (31.7% million hectares) of the total hot arid zone of India (Singh *et al.*, 23). Numerous highly beneficial and multipurpose plant species, including underutilized plant species are found in the area. *Cordia myxa* was previously found to have a fair diversity in Rajasthan (Meghwal *et al.*, 9) and Kachchh, Gujarat (Dev *et al.,* 5). Fair diversity was also noted in other *Cordia* species, including *C. sinensis*, *C. monoica* Roxb. *C. sebestena* L. and *C. perrottetii* Wt. in this region (Dev *et al.,* 5). In many regions of the world today, the demand for underutilized fruit crops are increasing day by day. Lasora is one of the popular underutilized fruit trees of arid and semi-arid regions of India, is locally known as gonda, lasora/lehsua or Indian cherry (English) belongs to the family Boraginaceae. This species is native to the area stretching from the eastern Mediterranean to eastern India (Oudhia, 11) and is widely grown across the country except at hills. The genus was named in honour of the 16th-century German botanist *E. Cordus*. Lasora is drought-tolerant, grows well on poor soils and has long been valued for its multipurpose uses. Immature fruits are consumed as vegetables and pickles, while mature fruits are eaten fresh, dried or processed into "panchkutta", a delicacy served in hotels and exported. Fresh fruits contain about 70–75 % mucilaginous pulp, 74–82.5 g water, 1.8–2 g protein, 1.0 g fat, 12.2 g carbohydrates, 0.3 g fibre, 40 mg calcium, 60 mg phosphorus and 114 mg ascorbic acid per 100 g (Oudhia, 11). Its fruit are astringent, anthelmintic, diuretic, demulcent and expectorant while other plant parts are used in curing various ailments *viz*. skin diseases, dropsy, dysentery, dyspepsia, cholera and headache etc. The availability of fruits is for very short duration and the shelf life of fresh fruits is also very short, which as

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such becomes almost unfit for human consumption within a week time of harvest. The fruit drop and low or no bearing of lasora is very common problem in this arid region of western Rajasthan and there were many causes (Biotic as well as abiotic) of this problem, the most probably factor of this disorder is timely defoliation of leaves.

Being deciduous with short-lived leaves, lasora requires a brief winter dormancy to synchronize flowering with the hot, dry season. Natural leaf fall occurs in February–March but delaying or advancing defoliation strongly influences fruiting and yield. Recent agro-techniques recommend withholding irrigation after the monsoon (Sharma *et al.*, 14) and supplementing natural leaf drop with manual or chemical defoliation specifically, foliar sprays of 1000 ppm 2-chloroethyl phosphonic acid (ethephon) in early January which promote new flush occurrence with new leaves and fruiting on auxiliary buds of current season growth (Meghwal *et al.*, 9). The fallen leaves are incorporated into the tree basin, and irrigation and fertilization resume in mid-February. These practices promote early, synchronized flushing and flowering and advance fruit harvest by 30–40 days (Vidhya *et al.*, 21). Field observations in 2021 likewise emphasize that defoliation combined with irrigation scheduling produces uniform fruiting and enhances yield and quality (Vidhya *et al.*, 21). Controlled experiments have confirmed these benefits. In a recent study evaluating manual defoliation and sprays of thiourea (TU), ethephon and di-ammonium phosphate (DAP), high concentrations of TU + ethephon + DAP (10 g + 4 ml + 10 g L^{-1}) reduced days to maturity and produced the highest fruit number, fruit weight and yield per plant and per hectare (Sheikh, 15). Manual defoliation was also effective and paralleled the chemical combination in yield (Meghwal *et al.*, 9). Ethephon treatments elevated TSS to 13.16 %, and the TU + ethephon + DAP combination achieved 12.93 % TSS, both significantly higher than the control. These treatments also increased flesh weight by over 40 % and reduced stone weight and the stone:flesh ratio. Economic analysis showed that the TU + ethephon + DAP treatment delivered the highest gross and net returns and the best benefit-to-cost ratio. Building on these insights, the present work investigates different methods of defoliation and plant growth regulator sprays to optimize yield and quality of lasora as an early crop.

MATERIALS AND METHODS

Lasora (Assyrian plum) plants naturally shade their leaves in month of March-April and flowering stars just after defoliation, which coincides with high wind velocity and high temperature that causes low yield and quality and late availability of fruits in the market which fetches low price. To get early crop it is necessary to defoliate plants in the month of January which produce early fruits of good quality (Fig. 1). The study was conducted on an 8-year-old lasora mother block of a local cultivar at ICAR-Central Arid Zone Research Institute, KVK Pali (Rajasthan), from December 2022 to June 2023. The site (25.801428° N, 73.291048° E) has uniform topography, adequate surface drainage, and sandy clay soil. Low rainfall and high evaporation (1,854 mm per year) contribute to slightly saline soil (pH 7.90). Soil organic carbon is low (0.29 %), with low available nitrogen (235.8 kg ha^{-1}) and medium P_2O_5 (14.33 kg ha^{-1}) and K_2O (210.33 kg ha^{-1}). During the study, temperatures ranged from 4.1 °C in winter nights to 41.2 °C in summer days; annual rainfall averaged 550.30 mm with irregular distribution, relative humidity remained between 20 % and 35 %, and wind speeds ranged from 30 to 40 km h^{-1}, (Kumar and Singh, 8) conditions that may influence transpiration and chemical absorption. The experimental block was fenced to prevent grazing and encroachment by livestock.

The established orchard has 6 × 6 m spacing. For defoliation study a randomized block design (RBD) with eight treatments and three replications was applied. To reduce variability, 24 uniform trees were selected from 36 available trees based on canopy size and previous year's yield performance. Treatments compared natural defoliation (control), manual defoliation and six spray combinations: Thiourea (5, 7.5 or 10 g) plus ethephon (2, 3 or 4 ml) and di-ammonium phosphate (5, 7.5 or 10 g) per litre of water; ethephon alone (4 ml L^{-1}); and 2,4-D at 4 ml L^{-1}. Foliar sprays were applied using 15 Liter

Fig. 1. Sequential steps of defoliation in lasora cultivation.

knapsack sprayers fitted with a hollow cone nozzle to ensure uniform droplet distribution, while manual defoliation was performed by skilled workers using ladders to strip leaves by hand. All treatments were applied during clear mornings in the last week of December to coincide with the natural dormancy period. Spray solutions were prepared fresh at the designated concentrations, using a small quantity of washing soda to reduce surface tension and improve foliar uptake. The lower-concentration solutions were sprayed first to avoid dilution or contamination. After treatment, each tree was tagged, and standard agronomic practices such as irrigation, weeding and pest management were continued uniformly across all treatments. Data were recorded at regular intervals on defoliation percentage at 10, 20 and 30 days after treatment (DAT); days to sprouting after defoliation; days to flower initiation after defoliation; fruit set percentage; days to fruit maturity after defoliation (DAD); fruit weight (g) measured using a digital balance; yield per plant (kg), Yield per hectare (Kg), and total soluble solids (TSS) measured with a handheld refractometer (Ahamad *et al.*, 2) ; and stone-to-flesh ratio determined by weighing pulp and seed. Standard formulas were employed to calculate the following parameters.

Data recorded on defoliation percentage, phenology, yield and quality attributes were subjected to analysis of variance (ANOVA) appropriate for the randomized block design with three replications per treatment. Treatment effects were tested for significance at the 5% level. When F-tests were significant, treatment means were separated using the least significant difference (LSD) test. Percentage data were arcsine-transformed before analysis and counts and weights were analyzed without transformation. Correlation coefficients among traits were computed to examine relationships between early sprouting, fruit set and yield. Normality and homogeneity of variance were checked prior to analysis, and computations were performed in SPSS.

RESULTS AND DISCUSSION

Different cultural practices like defoliation have become powerful tools to modify several physiological processes in plant which are extensively and profitably used in horticulture crops the mainly used in advances in crop, increasing size and weight of fruits which untimely results in high yield and good quality. The results of present study are presented below here under with statistical analysis.

The dataset clearly shows that manual defoliation (T_2) was by far the most effective method. Trees defoliated manually shed 100 % of their leaves within 10 days after treatment and remained completely defoliated at 20 and 30 days in both 2022-23 and 2023-24. In contrast, the control treatment (T_1) produced no defoliation at any sampling date. Among chemical treatments, the combination of thiourea 10 g + ethephon 4 ml + DAP 10 g per litre (T_5) induced the highest defoliation. In 2022-23 this treatment achieved mean defoliation of 85.1 % (89.6 % at 30 days), and in 2023-24 it still averaged 82.6 % with 87.5 % defoliation at 30 days. The intermediate mixture containing thiourea 7.5 g + ethephon 3 ml + DAP 7.5 g per litre (T_4) produced a mean of 78.2 % defoliation in 2022-23 and 78.1 % in 2023-24. The lower concentration mixture of thiourea 5 g + ethephon 2 ml + DAP 5 g per litre (T_3) gave moderate defoliation, averaging 62.1 % in 2022-23 and 64.4 % in 2023-24. Ethephon applied alone at 4 ml per litre (T_6) was less effective than the thiourea ethephon DAP mixtures, with mean defoliation of 58.8 % in 2022-23 and 61.4 % in 2023-24 (Fig. 2). Treatments with the auxin herbicide 2,4D were the least effective: spraying 3 ml L^{-1} (T_7) gave an average of only 31.9 % defoliation in 2022-23 and 35.6 % in 2023-24, while increasing the dose to 4 ml L^{-1} (T_8) yielded similar results (29.7 % and 35.2 %). These data indicate that manual defoliation remains the most reliable method, and that higher concentrations of thiourea and ethephon (ethylene releasing agents) markedly increase chemical defoliation compared with ethephon alone or 2,4D formulations. Abscission zone of most abscising organs like leaves are highly insensitive abscission, reported by Van and Wouter (20). Similarly, concentration of ethephon (600-1800 ppm) increased the defoliation from 26 to 94 per cent in Guava (Brar and Bal, 4) and in Pomegranate (Sheikh, 15 and Supe *et al.,* 19). Role of DAP is not clearly described by any scientist for defoliation. Meghwal *et al*. (9) also reported that foliar spray of 1000 ppm of 2-chloroethylene phosphonic acid {ethylene} during first week of January promoted defoliation in lasora in Rajasthan for crop regulation.

The dataset indicates that each treatment significantly influenced the time days to sprouting after defoliation (DSD). Natural defoliation (control, T_1) sprouted earliest, with shoots appearing about ten days after defoliation (9.99 days in 2022-23 and 10.23 days in 2023-24) (Fig. 2). This suggests that trees subjected to no defoliation quickly resumed growth. Manual defoliation (T_2) delayed sprouting relative to the control; new shoots emerged after roughly 16 days in both years (mean DSD ≈ 16.03 days). Among chemical treatments, the combination of thiourea 10 g + ethephon 4 ml + DAP 10 g L^{-1} (T_5) was the most effective dormancy breaking treatment.

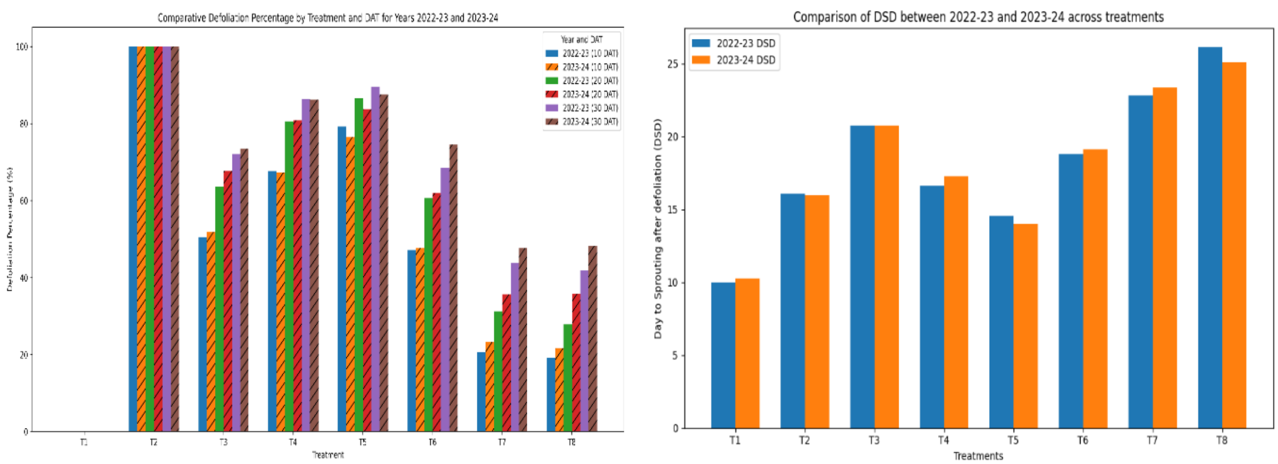


Fig. 2. Comparison of the defoliation percentage and days to sprouting after defoliation (DSD) across eight treatments in two consecutive years.

It promoted sprouting after about 14.56 days in 2022-23 and 14.00 days in 2023-24 (mean 14.28 days) earlier than the manual method and all other chemical treatments.

Intermediate concentrations of thiourea and ethephon also shortened dormancy but were less effective. Trees treated with thiourea 7.5 g + ethephon 3 ml + DAP 7.5 g L^{-1} (T_4) sprouted after about 16.62–17.27 days (mean 16.95 days), while the lowest concentration mixture (thiourea 5 g + ethephon 2 ml + DAP 5 g L^{-1}, T_3) delayed sprouting to approximately 20.73 days. Ethephon alone at 4 ml L^{-1} (T_6) had moderate efficacy, with sprouting after 18.77–19.09 days (mean 18.93 days). The auxin herbicide 2,4D produced the longest dormancy. Sprouting occurred after 22.78–23.33 days (mean 23.06 days) when applied at 3 ml L^{-1} (T_7), and after 25.06 – 26.10 days (mean 25.58 days) with 4 ml L^{-1} (T_8). These findings confirm that natural defoliation leads to immediate sprouting, high concentrations of thiourea and ethephon (with DAP) can effectively break dormancy and hasten sprouting, manual defoliation is somewhat slower, and 2,4D treatments significantly delay sprouting. This is probably caused due to use of dormancy braking chemicals *viz.* thiourea and ethephon. Thiourea increases starch content of cells and alters the protein structures there by increases C:N ratio of cell which broke dormancy (Rehman *et al.,* 13).

The dataset shows that natural defoliation (control, T_1) induced the earliest flowering, with shoots initiating after approximately 16.15 days. Manual defoliation (T_2) delayed flowering to about 23.03 days. Among chemical treatments, the high concentration mixture of thiourea 10 g + ethephon 4 ml + DAP 10 g L^{-1} (T_5) produced the earliest flowering (mean = 20.54 days). Moderate concentrations (T_4) induced flowering after ~22.83 days, whereas lower concentrations (T_3) delayed flowering to ~28.40 days. Ethephon alone (T_6) produced intermediate results (~25.02 days), while 2,4D treatments (T_7 and T_8) caused the longest delays (~30.6–30.7 days).

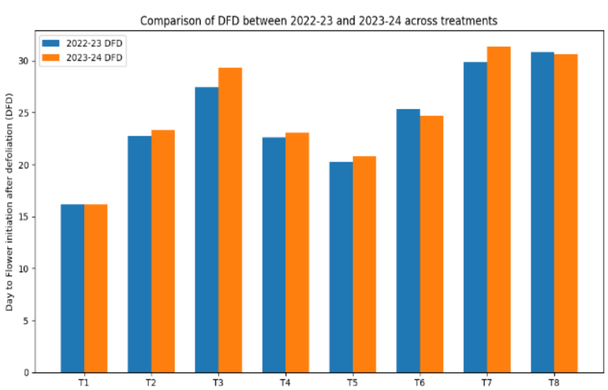
The trend that higher concentrations of thiourea combined with ethephon (an ethylene releasing agent) reduce the delay in flower initiation aligns with evidence that exogenous ethylene analogues promote flower formation. For instance, in pumpkin, ethephon application significantly increased the number of female flowers and expedited the appearance of the first female flower (Li *et al.*, 10), likely because ethylene activates genes involved in hormone signalling (Li *et al.*, 10). Thiourea has long been used to break seed dormancy and stimulate germination (Waqas *et al.*, 23); when combined with ethephon, it may reduce the latency to flowering by mobilizing stored nutrients and promoting growth. These results were also recorded in mango fruit drop (Tandel and Patel, 28) in pomegranate (Sheikh, 15), in custard apple (Vinay and Chithiraichelvan*,* 22). Application of thiourea can induce flowering in certain varieties of mango in off season. This effect of thiourea on flowering might be due to its bio-regulatory effect chiefly through mobilization of dry matter and translocation of photosynthates to sink (Mishra *et al*., 10). DAP is providing nitrogen and this may be attributed to the role of nitrogen in accelerating plant growth.

The fruit set percentage in Lasora was enhanced by T.U. + Ethephon + DAP treatments (19 to 20.78) followed by manual method (17.40), Ethephon 4 ml/litre (15.40), 2,4-D treatments (14.33 & 13.77) over control (9.03). Defoliation treatments had a pronounced effect on fruit set in lasora. Natural defoliation (control, T_1) produced the lowest fruit set, averaging only 10.88 % across 2022-23 and 2023-24 (Fig. 3). Manual defoliation (T_2) increased fruit set to 18.85 %. The combinations of thiourea (T.U.), ethephon and DAP were most effective: the moderaterate mixture (T_4: 7.5 g T.U. + 3 ml ethephon + 7.5 g DAP per litre) recorded the highest fruit set (21.06 % in 2022-23 and 21.83 % in 2023-24), closely followed by the lowrate mixture (T_3: 5 g T.U. + 2 ml ethephon + 5 g DAP) at 20.89–21.63 % and the highrate mixture (T_5) at 19.50–21.93 %. Thus, both low and moderate concentrations of T.U. + ethephon + DAP produced similar improvements in fruit set, slightly outperforming the highrate treatment. Ethephon alone (T_6) was less effective, with fruit set of 15.33–16.27 %, while 2,4D treatments (T_7 and T_8) were the least effective among chemical treatments, averaging 15.96 % and 13.98 % respectively.

These trends align with known physiological effects. Ethephon releases ethylene, a hormone that promotes floral initiation; exogenous ethephon has been shown to increase the number of female flowers and accelerate their appearance in pumpkin. Thiourea is widely used to break seed dormancy and stimulate germination, mobilizing reserves that can support new growth (Waqas *et al.*, 23). Combining thiourea with ethephon and nitrogenous DAP therefore appears to improve reproductive development in Lasora, resulting in higher fruit set. In contrast, 2,4D (a synthetic auxin) can induce parthenocarpic fruit development but tends to produce smaller fruit and lower drymatter content (Wu *et al.*, 24), which may explain the comparatively low fruitset percentages observed in treatments T_7 and T_8. These findings are inconsistent with Jana and Das (6) on Asian pear, ethephon (600 and 1000 ppm) induces higher fruit set percent in various mango varieties in India and Philippines.

The findings show a clear hierarchy in how defoliation treatments influence fruit maturity in lasora. The quickest maturation occurred under ethephon-rich regimes: Ethephon alone (4 ml L^{-1}) shortened the maturity period to about 54 days, while the highrate thiourea–ethephon–DAP mixture yielded a similar result at ≈54.8 days (Fig 4). Reducing the rate of the mixture led to progressively slower ripening (≈56.8 days for the intermediate rate and ≈58.8 days for the lowest rate), but these were still faster than manual defoliation (≈62.5 days) and the natural control (≈62.7 days). In contrast, auxin-based defoliants were least effective: even the higher concentration of 2,4-D matured fruit only marginally sooner than its lower rate (≈63.0 vs. ≈63.9 days). Achieving uniform, timely ripening is important because unregulated crops suffer from nonsynchronised maturity, which hampers quality and market timing. Thus, deploying ethephon (alone or in combination with thiourea and DAP) not only accelerates sprouting and flowering but also brings fruit to harvest more quickly, allowing growers to target early-season markets and capture premium prices. These results are in confirmation with results obtained by Singh and Dwivedi (18) in mango and Rathod *et al*. (12) in pomegranate.

The combined application of thiourea, ethephon and DAP markedly increased fruit weight relative to the control. Mean fruit weight for the highestrate mixture (T_5) reached 8.13 g, with the medium (T_4) and low (T_3) rates averaging 8.02 g and 7.55 g, respectively. Manual defoliation (T_2) also improved fruit weight to about 6.94 g, substantially higher than the natural control (T_1, 6.21 g). In contrast, ethephon alone (T_6) yielded only 6.70 g, only a slight increase over the control, while 2,4D treatments produced 6.61 g (3 ml L^{-1}) and 6.56 g (4 ml L^{-1}) (Fig. 4). Thus, among the treatments tested, the thiourea ethephon



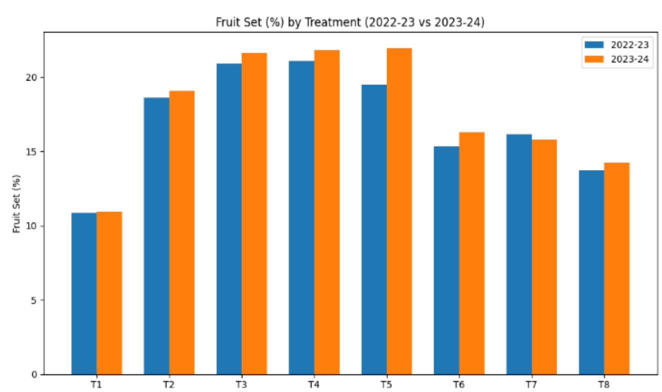


Fig. 3. Comparison of the days to flower initiation after defoliation (DFD) and fruit set (%) across eight treatments in two consecutive years.

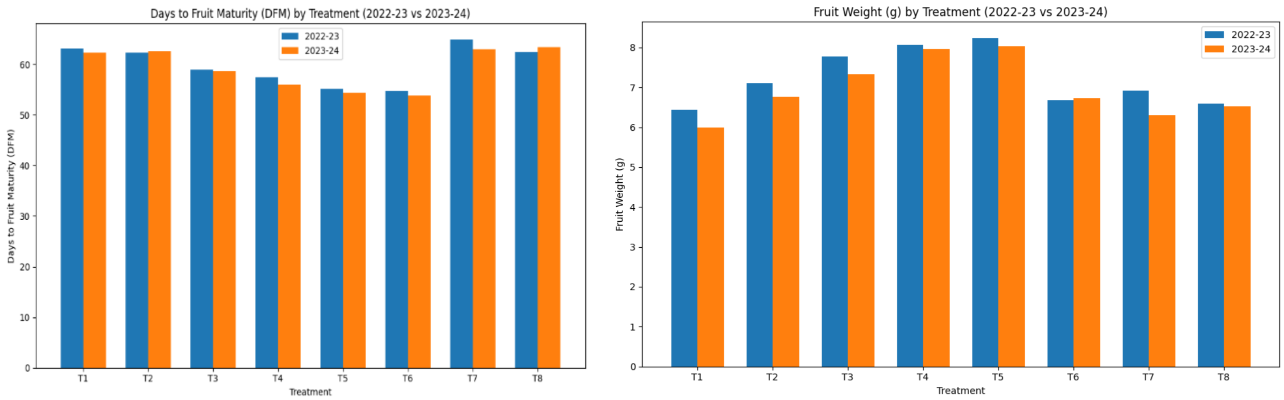


Fig. 4. Comparison of the days to fruit maturity and fruit weight (g) across eight treatments in two consecutive years.

DAP mixtures were most effective at enhancing fruit weight, followed by manual defoliation, whereas ethephon alone and 2,4D treatments offered little or no advantage over the untreated control. These finding are in accordance with finding of Jana and Das (6) in Asian pear with thiourea and Rathod *et al*., (12) in pomegranate with ethereal.

The defoliation treatments markedly influenced lasora yield. Across both years, the highest yields were obtained with the thiourea 10 g + ethephon 4 ml + DAP 10 g L^{-1} treatment (T5), which produced an average of ≈62.6 kg per plant and ≈168 quintals ha^{-1} (≈16.8 t ha^{-1}) (Fig. 5). Slightly lower but still substantial yields were recorded for the medium (T_4) and low (T_3) thiourea ethephon DAP mixtures around 53.6 kg and 48.2 kg per plant with perhectare yields of ≈139.4 q and ≈125.3 q, respectively. Manual defoliation (T_2) also raised productivity to ≈54.7 kg per plant and ≈142.7 q ha^{-1}, outperforming the control by a wide margin. Ethephon alone (T_6) gave moderate gains, with about 50.7 kg per plant and ≈133.6 q ha^{-1}, whereas 2,4D treatments (T_7 and T_8) yielded far less only ≈40.1 and ≈35.4 kg per plant and ≈106.5 and ≈94.8 q ha^{-1}, respectively. Natural defoliation (T_1) remained the least productive, averaging ≈31.2 kg per plant and ≈85.5 q ha^{-1}. Overall, thiourea plus ethephon plus DAP treatments substantially increased yields per plant and per hectare compared with the control and with 2,4D or ethephon alone, highlighting the importance of these growth regulators in maximizing productivity. These finding are confounding with Jana and Das (6) which reported that application of thiourea resulted in modification of C:N ratio of shoots gave maximum fruit yield in Asian pear. Significant results were found by Supe *et al*. (19) in pomegranate with ethephon.

The two year data show only modest differences in TSS among treatments. Mean TSS values ranged from about 11.9 % to 12.9 %, with most treatments clustering near 12.50 %. Natural defoliation (control, T_1) produced a mean TSS of ≈12.28 % (Fig. 6). Manual defoliation (T_2) consistently enhanced TSS, yielding ≈12.72 % on average, the highest among treatments. All combinations of thiourea, ethephon and DAP slightly increased TSS relative to the

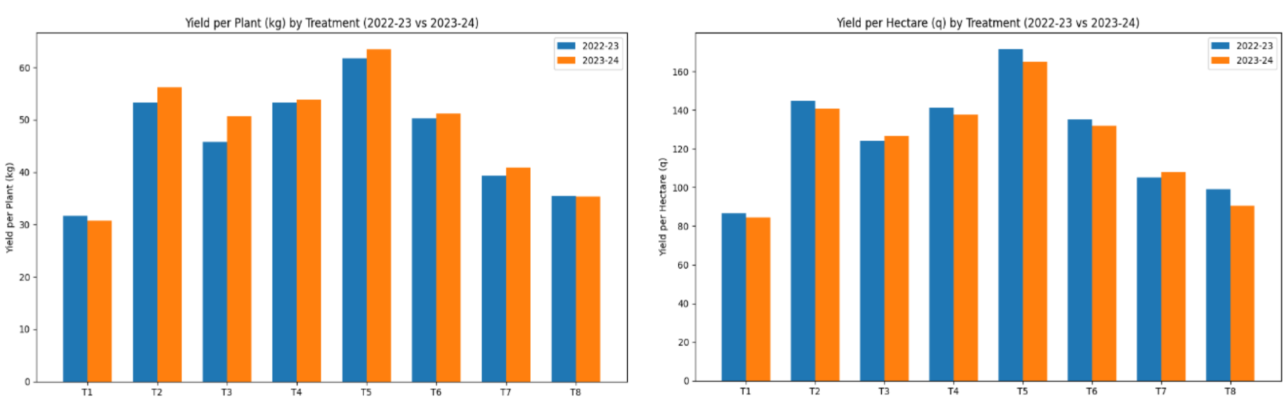


Fig. 5. Comparison of the yield per plant (kg) and yield per hectare (q) across eight treatments in two consecutive years.

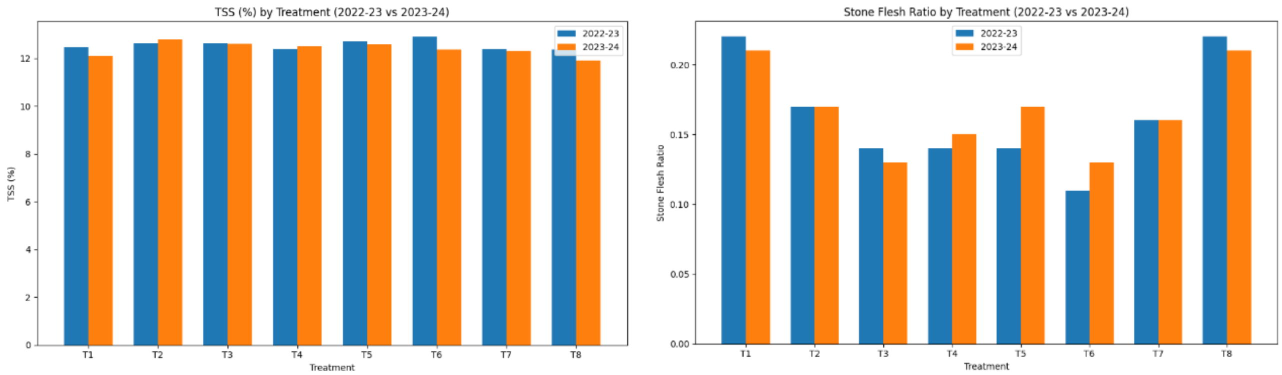


Fig. 6. Comparison of the total soluble solids (%) and stone: flesh ratio across eight treatments in two consecutive years.

control. The high rate mixture (T_5: 10 g T.U. + 4 mL ethephon + 10 g DAP L^{-1}) averaged ≈12.64 %, while intermediate (T_4) and low (T_3) rates yielded ≈12.45 % and ≈12.62 % respectively. Ethephon alone (T_6) produced the highest single year value (12.89 % in 2022-23), but because its second year value was lower (12.37 %), the two year average (≈12.63 %) was similar to T_5. Auxin based defoliants (2,4D treatments T_7 and T_8) were less effective; their mean TSS values (≈12.35 % and ≈12.13 %) were lower than those of the thiourea ethephon DAP mixtures but still slightly above the control. Overall, the data suggest that manual defoliation and high concentrations of thiourea plus ethephon plus DAP give the most consistent increase in TSS, whereas 2,4D treatments offer little advantage over the natural control. These finding are conformed to the finding of Singh *et al.* (16) who reported high TSS in guava with 500 ppm ethephon and Singh and Reddy (17) who reported that 1800 ppm ethephon recorded maximum TSS in guava. Ahamad *et al.* (1) and Kumar and Nath (7) obtained maximum TSS fruit treated with brassinosteroids in cherry tomato and ethrel in litchi respectively.

The stone : flesh ratio (lower values indicate more pulp relative to the stone) varied markedly across treatments. The control (T_1) produced a high stone : flesh ratio of ≈0.215 (0.22 in 2022-23 and 0.21 in 2023-24). Manual defoliation (T_2) reduced this to 0.17 in both years. Among chemical treatments, ethephon alone (T_6) yielded the most favourable ratio, with values of 0.11 and 0.13 and a two year mean of ≈0.12 (Fig. 6). The three thiourea + ethephon + DAP mixtures produced intermediate ratios: T_3 averaged ≈0.135, T_4 ≈0.145, and T_5 ≈0.155. These combinations were thus better than manual defoliation but did not match the low ratio achieved with ethephon alone. The auxin treatment 2,4,D at 3 mL L^{-1} (T_7) resulted in a moderate ratio (0.16 in both years), whereas the higher concentration (T_8) mirrored the control, with values of 0.22 and 0.21. Overall, ethephon alone produced the lowest stone : flesh ratio, followed by the thiourea based mixtures, while high rate 2,4,D offered no improvement over the untreated control. This result obtained full support from the finding of Brahmachari *et al.* (3) who purposed that ethephon in guava reduced seed weight and increased pulp: seed ratio.

The overall conclusion of this study demonstrate that strategic defoliation, particularly when combined with thiourea and ethephon, is a powerful tool to advance crop maturity and improve fruit yield and quality in lasora.

AUTHOR'S CONTRIBUTION

All authors were actively involved in research conceptualization, gathering data, analysis and manuscript preparation. Conceptualization of research (DS); Designing of the experiments (DS, CK); Analysis of data and interpretation (CK, RD); Preparation of manuscript (DS, CK, RD).

DECLARATION

All authors agree to publication and any conflict of interest in the manuscript.

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REFERENCES

1. Ahamad, S., Asrey, R., Menaka, M., Vinod, B. R., Kumar, D. and Balubhai, T. P. 2025. 24-Epibrassinolide treatment boosts bioactive compound preservation, delays softening and

extends shelf life of cherry tomatoes during storage. *Food Chem.*, 145051.

2. Ahamad, S., Asrey, R., Vinod, B. R., Meena, N. K., Menaka, M., Prajapati, U. and Saurabh, V. 2024. Maintaining postharvest quality and enhancing shelf-life of bell pepper (*Capsicum annuum* L.) using brassinosteroids: A novel approach. *S. Afr. J. Bot.*, **169**: 402-412.

3. Brahmachari, V.S., Mandal, A.K., Kumar, R. and Ray, R. 1995. Effect of growth substances on fruit-set and physiochemical characteristics of Sarder guava (*Psidium guajava* L.). *Recent Horti.* **2**: 127-131.

4. Brar, J.S. and Bal, J.S. 2010. Role of paclobutrazol and ethephon in reproductive growth of 'Allahabad Safeda' guava (*Psidium guajava* L.) plants at different spacing. *J. Horti. Sci.* **5**: 128-133.

5. Dev, R., Suresh K.M., Kumar, S., Venkatesan, K., Singh, T., Tetarwal, A.S., Patidar, A., Devi, D. and Meghwal, P. 2020. Collection, characterization, conservation and utilization of *Cordia sinensis* Lam.: An underexploited multipurpose fruit species of hot arid regions. *Indian J. Plant Genetic Res.* **8**: 427–436.

6. Jana, B.R. and Das, B. 2014. Effect of dormancy breaking chemicals and irrigation on Asian pear (*Pyrus pyrifolia* L.). *African J. Agri. Res.* **9**: 56-60.

7. Kumar, A. and Nath, V. 2017. Effect of foliar spray of chemicals on flowering and fruiting in litchi. *Int. J. Cur. Micro. & Applied Sci.* **6**: 1337-1343.

8. Kumar, C. and Singh, D. 2025. Musk melon cultivation on reservoir basin: A climate smart and profitable farmer practice in arid zone of Rajasthan. *Indian J. Ecology* **52**: 975-979.

9. Meghwal, P.R., Singh, A., Kumar, P. and Morwal, B.R. 2014. Diversity, distribution and horticultural potential of *Cordia myxa* L.: a promising underutilized fruit species of arid and semi-arid regions of India. *Genetic Res. and Crop Evo.* **61**: 1633–1643.

10. Mishra, S., Choudhary, M.R., Yadav, B.L. and Singh, S.P. 2011. Studies on the response of integrated nutrient management on growth and yield of Ber. *Indian J. Horti.* **68**: 318-321.

11. Oudhia, P. 2007. *Cordia myxa* L. [Internet] Record from PROTA4U. Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa/Resources Végétales de l'Afrique tropicale), Wageningen, Netherlands www.prota.org.

12. Rathod, M.J., Ramdevputra, M.V., Nurbhanej, K.H. and Patel, M.S. 2017. Effect of ethrel and banana pseudostem sap on fruit yield and yield attributes of pomegranate (*Punica granatum* L.) Bhagwa. *Int. J. Chemistry Stu.* **5**: 392-396.

13. Rehman, F., Seung, K.L. and Joung, H. 2002. Effects of various chemicals on carbohydrate content in potato micro tubers after dormancy breaking. *J. Plant Sci.* **1**: 224-225.

14. Sharma, S.K., Singh, R.S. and Bhargava, R. 2013. Arid horticulture: An overview. *Annals of Arid Zone* **52**: 251-264.

15. Sheikh, M.K. 2014. Effect of chemicals and insecticides on defoliation in pomegranate (*Punica granatum* L.). *Asian J. Horti.* **9**: 265-266.

16. Singh, D., Kumar, C., Choudhary, M. K. and Mahla, H. R. 2018. Indian arid zone miracle plants for food and livelihood security. *Int. J. Minor Fruits, Medicinal and Aromatic Plants* **4**: 01-12.

17. Singh, G. and Reddy, Y.T.N. 1997. Regulation of Cropping in guava. *Indian J. Horti.* **54**: 44-49.

18. Singh, R. and Dwivedi, U.N. 2008. Effect of ethrel and 1-methyl cyclopropane (1-MCP) on antioxidants in mango during ripening. *Food Chem.* **111**: 951-956.

19. Supe, V.S., Joshi, V.R, Patil, S.D. and Attar, A.V. 2015. Effect of different chemicals on leaf shedding of pomegranate 'Bhagwa'. *Acta Horti.* 437-442.

20. Van, D. and Wouter, G. 2001. Effect of ethylene on flower abscission: a Survey. *Annals of Bot.* **89**: 689-693.

21. Vidhya, D., Sivakumar, V. and Balakumbahan, R. 2021. LASORA - Fruit for arid and semiarid landforms. *Vigyan Varta* **2**: 63-67.

22. Vinay, G.M. and Chithiraichelvan, R. 2015. Induction of off-season flowering in custard apple

(*Annona squamosa* L.) cv. Balanagar. *J. Horti. Sci.* **10**: 13-17.

23. Waqas, M.A., Kaya, C., Riaz, A., Farooq, M., Nawaz, I., Wilkes, A. and Li, Y. 2019. Potential mechanisms of abiotic stress tolerance in crop plants induced by thiourea. *Frontiers in Plant Sci.* **29**: 1336.

24. Wu, L., Dong, J., Zheng, H., Wang, Y., Qiu, D., Atak, A., Zhang, Q. and Zhong, C. 2025. Effects of plant growth regulator (2,4-D) treatments on fruit development and chemical content in the kiwifruit plant (*Actinidia chinensis*). *BMC Plant Biol.* **25**: 1073.

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