Crop regulation in guava through different crop regulating treatments

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ABSTRACT
In order to study various factor effects on guava crop, cv Allahabad Safeda trees were sprayed, at bloom stage in April, with ethephon, napthelen acetic acid, fertilizer grade urea and potassium iodide. These treatments were repeated two weeks later; pruning of current season's growth was done at the same time. Some of these treatments induced complete abscission of leaves; others produced the all flowers and flower buds abscission. This resulted in drastic reduction of fruit yield during the rainy season. During the winter season, plants receiving 10% urea significantly produced the highest yield (84.81 kg/plant). In comparison, untreated control plants yielded 25.83 kg/plant. In some treatments, the total soluble solid rate of the fruit was also improved.

Contrôle du rendement chez le goyavier par utilisation de différents traitements.

RÉSUMÉ
Pour étudier l'influence de différents facteurs sur la production du goyavier, des arbres du cultivar Allahabad Safeda ont reçu, lors de leur floraison en avril, des pulvérisations d'éthéphon, d'acide naphtalène acétique (ANA) et une fertilisation avec diverses doses d'urée et d'iodure de potassium (KI) ; ces applications ont été renouvelées 2 semaines plus tard, en même temps qu'était effectuée une taille plus ou moins sévère des pousses de l'année. Certains de ces traitements ont occasionné une complète abscission des feuilles ; d'autres ont entraîné la destruction de la totalité des boutons floraux et des fleurs. Les récoltes de goyaves effectuées en saison des pluies ont alors été très diminuées. En hiver, ce sont les arbres ayant reçu une fertilisation d'urée à la dose de 10 % qui ont été les plus productifs (84,81 kg/plant de goyaves) ; par comparaison, les goyaviers témoins, non traités, ont donné 25,83 kg/plant. Dans certains cas, le taux en sucres des fruits a pu être également amélioré.

Contról del rendimiento del guayabo utilizando diferentes tratamientos.

RESUMEN
Para estudiar la influencia de diferentes factores sobre la producción del guayabo, unos árboles del cultivar Allahabad Safeda recibieron, durante su floración en abril, pulverizaciones de etefon, de ácido naftalina acético (ANA) y una fertilización con diversas dosis de urea y de yoduro de potasio (KI); estas aplicaciones fueron repetidas dos semanas después, al mismo tiempo que se efectuó una poda más o menos severa de los brotes del año. Algunos de estos tratamientos ocasionaron una abcisión completa de las hojas; otros ocasionaron la destrucción de la totalidad de los botones florales y de las flores. Las cosechas de guayabos efectuadas en estación de lluvia fueron entonces muy disminuidas. En invierno, los árboles que recibieron una fertilización de 10 % de urea fueron los más productivos (84,81 kg/planta de guayabos); en comparación los guayabos testigos, sin tratar, dieron 25,83 kg/planta. En ciertos casos, el porcentage de azúcares de las frutas se pudo igualmente mejorar.

KEYWORDS
India, *Psidium guajava*, yields, seasonal variation, pre-harvest treatment, ethephon, napthelen acetic acid, urea, iodides, pruning, abscission, leaves, flowers.

MOTS CLÉS
Inde, *Psidium guajava*, rendement, variation saisonnière, traitement avant récolte, ethephon, acide naphtalène acétique, urée, iodure, taille, abscission, feuille, fleur.

PALABRAS CLAVES
India, *Psidium guajava*, rendimiento, variación estacional, tratamiento, etefón, ácido naftalina acético, urea, yoduros, poda, abscisión, hojas, flores.

introduction

There is a distinct difference in quality in the fruits produced in different seasons, and winter is considered to be more favourable for quality guava production (RATHORE and SINGH, 1974; PANDEY et al, 1980; SINGH, 1985). Though rainy season crops give higher yields, the fruit is often infested by many pests and diseases (RAWAL and ULLASA, 1988), and they are rough, insipid and watery, with poor quality and less nutritive value (CHUNDAWAT et al, 1976; SYAMAL et al, 1980). They also spoil rapidly due to a loss of the glossy appearance with discoloration followed by blemishes, desiccation and loss of firmness, protopectin and vitamin C after harvest (SINGH et al, 1981). In financial terms, the winter season crop is more profitable than the rainy season, due to high selling rates and less damage to the fruits by diseases and pests. Recently, SINGH et al (1991) studied the various cropping patterns and recommended a single winter crop in 1 year in order to harvest a highly economical crop of the best quality fruits.

Defoliation and/or pruning are the main methods to force the axillary buds to shoot. A great variation exists in the response to the chemicals and pruning tried for this purpose, which may be due to various factors that have been studied.

Six hundred ppm napthelen acetic acid (NAA) or pruning of three-quarters of the current season's growth are better treatments for the variety Sardar, under Pant Nagar conditions (PANDEY et al, 1980; TIWARI and RAM, 1984). RATHORE (1975) recommended 100 ppm NAA for Allahabad Safeda under Delhi conditions; SINGH et al (1989) and GUPTA and NIJJAR (1978) defined 600 ppm NAA for Varanasi in Punjab area. DWIVEDI et al (1990) and RAJPUT et al (1986) recommended 15% urea for Faizabad and Varanasi, and 10% urea was observed to be optimum concentration for yelding better crops during winter for Sardar and Allahabad Safeda under the Lucknow and Punjab areas (SINGH et al, 1992; SINGH and SINGH, 1994). The present report describes the effect of different chemicals and pruning intensities on induction of winter crop in guava.

materials and methods

The trials were conducted in India, at the Central Institute for Subtropical Horticulture, Lucknow, on twelve-year-old budded guava plants, Cv Allahabad Safeda.

The trees were planted at 5 m x 5 m and maintained under uniform cultural practices. Sixteen treatments were randomly allocated in a randomized block design having three replications with one tree per treatment. Five uniform size branches spread all over the directions of the tree were randomly selected and were kept under constant observation.

Whole trees were sprayed with ethephon (600, 1,200 and 1,800 ppm), NAA (200, 400 and 600 ppm), fertilizer grade urea (10, 15 and 20%), and potassium iodide (0.5, 1.0 and 2.0%) at bloom stage included a wetter (0.1%) Tween 20 (polyoxyethylene sorbitan monolaurate). Spraying was carried out with a Maruti foot-operated sprayer (450 ml/min) using a Duromist spray nozzle. All sprays were applied at bloom stage in the third week of April with a temperature of 35.88 - 20.56 °C max and min, and repeated in the second week of May (39.80 - 23.33 °C).

Pruning of the current season's growth (50, 75 and 100%) was performed on 10 May.

Control trees were compared with sprayed and pruned trees. Observations, both qualitative and quantitative, were made: abscission (leaves and flowers), fruit yield (rainy and winter seasons), mean fruit weight and fruit size were noted. Data were analyzed according to Duncan's multiple range test (LITELL, 1989).

results and discussion

Extensive leaf and flower abscission resulted from urea (15 and 20%), potassium iodide (all concentrations), NAA (600 ppm), ethephon (1,800 ppm) and 100% removal of the current season's growth as indicated in table I. Leaf abscission was not significantly different ($P > 0.05$) under the treatment of NAA (600 ppm) and ethephon (1,800 ppm). Of the chemicals applied as a foliar treatment, urea (20%) and potassium iodide (1 and 2%) caused 100% abscission.

Table I
Effect of different pruning intensities and chemicals on pattern of abscission and fruit yield during rainy and winter seasons in guava Cv Allahabad Safeda.

Treatment	*% Abscission*		*Fruit yield (kg/plant)*	
	Leaf	*Flower*	*Rainy season*	*Winter seaon*
Ethephon (ppm)				
600	29.36 f	86.45 abc	8.96 d	42.29 cde
1,200	39.35 e	94.18 ab	6.37 e	45.5 bcd
1,800	58.69 d	100.0 a	0.5 g	60.41 b
NAA (ppm)				
200	27.40 f	93.65 ab	6.13 e	40.07 cde
400	45.64 e	96.63 ab	3.25 f	40.27 cde
600	60.51 d	100.0 a	0.29 g	59.21 b
Urea (%)				
10	79.86 c	80.65 bc	5.13 e	84.81 a
15	89.81 b	100.0 a	0.66 g	33.98 cd
20	100.0 a	100.0 a	0.0 g	11.17 f
Potassium iodide (%)				
0.5	97.87 a	100.0 a	2.88 f	61.60 b
1.0	100.0 a	100.0 a	0.0 g	53.36 bc
2.0	100.0 a	100.0 a	0.0 g	26.85 e
Pruning of new shoot (%)				
50	55.45 d	45.63 d	16.18 c	40.0 cde
75	75.60 c	74.02 c	9.29 d	35.99 de
100	100.0 a	100.0 a	0.0 g	35.36 de
Control (untreated)	5.17 g	45.09 d	31.76 b	25.83 ef
F test	*	*	*	*

* Mean seperation within column's by Duncan's multiple range test ($P = 0.05$).

Two abscission zones were formed: one just below the thallamus, ie, in the pedicellar region, and the other at the junction of the peduncle and the shoot. After the flower buds dropped from the pedicellar region, the peduncle started to turn brown and dry up from the distal end (the portion just below the bud), progressing towards the base until finally dropping off. The browning reaction in the peduncle region may have been the result of translocation and concentration of chemicals in the peduncle following the application of the chemicals to the other parts.

PANDITA and JINDAL (1991) reported that, in apple, activation of the abscission zone at the pedicel spur junction is related to an increase in the endocellulase and soluble protein content. They observed that the separation of the cell began in the cortex region and progressed towards the vascular tissue. The cell separation of the cortex resulted from dissolution of the middle lamella but the vascular tissues ruptured mechanically..

In guava, flower and leaf abscission showed varying responses with different chemicals.

Potassium iodide rapidly stimulated leaf abscission leaving only the apical bud (shoot apex). After leaf abscission, flower buds and flowers remained on the shoots and abscissed later on. The role of potassium iodide in inducing the process of abscission has not been extensively studied. HERRETT et al (1962) postulated that the iodine ion induces abscission by increasing decomposition or interfering with the biosynthesis of indole acetic acid within the leaf. However, its application has increased the enzyme activity, and the increased cellulase activity may result primarily in dissolution of cellulosic cell wall, causing the leaves to abscisse spontaneously (ABELES et al, 1971).

The effect of NAA appeared with twisting of leaves after the spray, followed by the dropping of flowers. NAA completely destroyed the emerging growth (shoot apex) and then the leaves abscissed. The abscission was greatest at the point of attachment of the pedicel with the flower (SINGH et al, 1992).

The effect of urea sprays was apparent within three days. They caused leaf scorching, followed by abscission. The treatment of urea (15 and 20%), however, produced severe foliage burn. Similar observations were recorded with urea sprays on guava by RAJPUT et al (1986). SHIGEURA et al (1975) and CHAPMAN et al (1979) reported that urea (25%) was an optimum concentration for defoliation, fruit set and early cropping in guava. The difference in response could be due to cultivar and environmental conditions. ADDICOTT (1964) indicated that most defoliants have no direct effect on the abscission zone, but affect abscission by way of leaf injury which sets in motion the chain of events leading to leaf fall.

It is now well known that inducing ethylene production plays a role in abscission (ABELES et al, 1971). Ethephon sprays caused abscission of flowers and flower buds within four to ten days. Flower and flower buds were more sensitive than leaves. However, the leaves may have been more sensitive to some chemicals because their surface area was larger than that of flower buds and flowers. This could be due to earlier formation of the abscission layer in leaves. ABELES et al (1971) conducted a detailed study of the mechanism of leaf abscission and reported that higher levels of endogenous ethylene enhance the activity of cellulase at the abscission layer. However, it is evident from the present study that the exogenous application of ethylene also contributes to enhancement of cellulase activity during abscission (SINGH and SINGH, 1993).

Table II
Effect of different pruning intensities and chemicals on quality components of Allahabad Safeda guava fruits.

Treatments	*Mean fruit weight (g)*	*Mean fruit length (cm)*	*Mean fruit diameter (cm)*	*TSS° Brix (%)*	*Ascorbic acid (mg/100 g)*	*Total sugar* (%)*	*pH*
Ethephon (ppm)							
600	98.86	5.87	5.80	9.33	215.04	5.96 d	4.23
1200	91.70	5.62	5.63	9.40	225.25	5.70 d	4.27
1800	105.17	5.83	5.68	11.20	209.23	6.61 bcd	4.31
NAA (ppm)							
200	104.00	5.82	5.73	11.47	194.62	7.23 abcd	4.26
400	125.53	6.27	5.96	10.70	183.40	7.75 abc	4.35
600	157.96	6.72	6.63	9.50	230.20	6.47 cd	4.29
Urea (%)							
10	12.33	5.56	5.34	13.27	169.48	8.12 abc	4.35
15	109.46	6.02	5.67	12.93	155.98	8.48 a	4.21
20	90.33	6.26	5.70	13.20	162.62	8.41 a	4.29
Potassium iodide (%)							
0.5	97.50	5.73	5.64	13.13	180.50	8.34 ab	4.32
1.0	79.67	5.16	5.37	13.67	178.47	8.57 a	4.17
2.0	98.04	5.43	5.55	10.87	162.57	6.92 abcd	4.28
Pruning of new shoot (%)							
50	102.17	5.87	5.68	13.93	148.67	8.19 abc	4.22
75	93.50	5.44	5.58	11.07	136.49	6.80 abcd	4.23
100	104.00	5.88	5.51	13.80	207.25	8.38 a	4.33
Control (untreated)	104.00	5.17	5.49	10.53	176.05	6.57 cd	4.24
F test	NS	NS	NS	NS	NS	*	NS

* Mean separation within columns by Duncan's multiple range test ($P = 0.05$)
NS: Not significant

The winter crop yield was significantly increased with urea (10%) spray as compared with control and other treatments (table I). In those, where maximum flowers and flower buds occurred, the yield did not follow the same pattern during the winter season (table II). It was further observed that there was no direct association between the percentage of flower abscission and yield during winter (table I).

Of the chemicals and different pruning intensities reported in the trial, urea (10%) produced significantly ($P < 0.05$) higher yield (84.81 kg/tree) followed by potassium iodide 0.5% (61.60 kg/tree), 1,800 ppm ethephon (60.41 kg/tree) and 600 ppm NAA (59.21 kg/tree) during the winter season. The untreated control trees had a yield of 25.83 kg/tree.

Not much appreciable increase in yield was recorded during the winter season under the treatment of different pruning intensities.

Defoliation with urea sprays (SHIGEURA et al, 1975; CHAPMAN et al, 1979; SHIGEURA and BULLOCK, 1976; SINGH, 1991; SINGH et al, 1992; SINGH and SINGH, 1994) or with ethephon and NAA (PANDEY et al, 1980; SINGH et al, 1989) has been applied to change the yield pattern from scattered bearing to a concentrated peak harvest during the desired period. The pruning of new shoots to one-third of their length in early May was found to cause a crop distribution pattern of 70 and 30% during the winter and rainy season, respectively (TIWARI and RAM, 1984). However, there are varietal differences in response to the different chemicals and pruning intensities. This variation may be due to several factors such as cultivar, tree condition, soil type and environment (SINGH, 1991). Hence, still more comprehensive studies on deblossoming guava trees of various cultivars under different local conditions, through chemical manipulation, are needed.

Insignificant differences were observed in qualitative characters except total sugar (table II). Fruit weight was highest with NAA (600 ppm), followed closely by 400 ppm NAA and 10% urea. The minimum fruit weight was observed when 1.0% potassium iodide was sprayed. RAJPUT et al (1986) also reported that weight and fruit size were markedly reduced with urea sprays beyond 15% concentration.

The highest total soluble sugar (°Brix) was observed with 50% pruning intensity, followed by 1.0% potassium iodide and 10% urea. The latter two treatments were equivalent to each other. There was wide variation in the amount of ascorbic acid, total sugar and pH.

The present studies demonstrate that the spray application of urea (10%) is better for crop regulation in guava. Therefore, it can be recommended in guava when winter crop is desirable.

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