JUST AGRICULTURE
multidisciplinary e-Newsletter

Advances in Use of PGRS in Date Palm

Bhakti B. Panchal
Scientist-Horticulture, KVK, NAU, Surat

ARTICLE ID: 05

Plant growth regulators

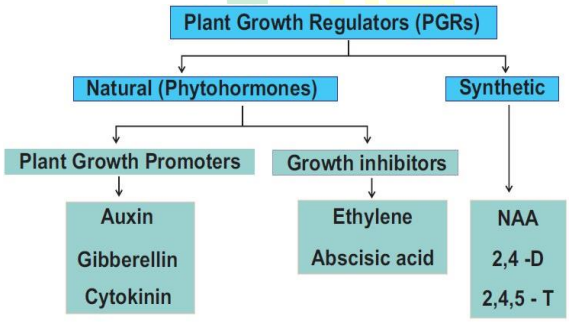
Introduction:

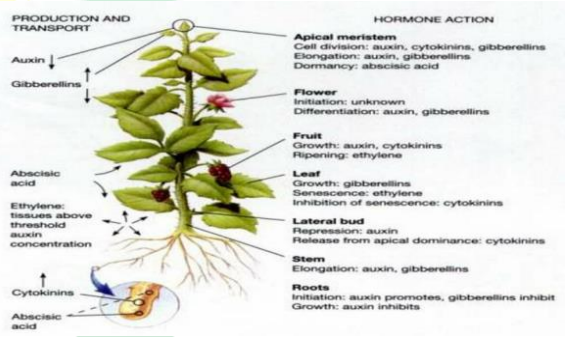
What is Plant Growth Regulators?

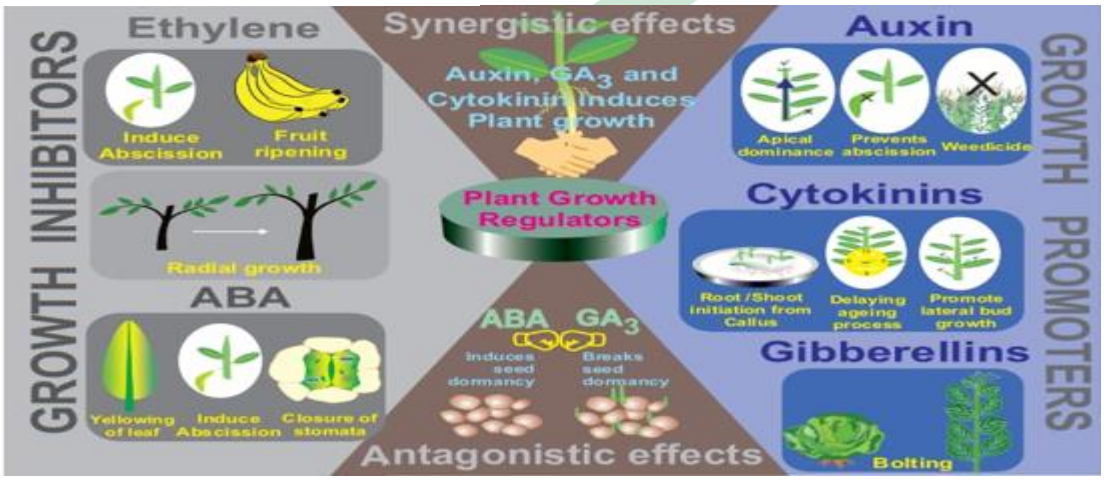
A growth regulator is an organic compound, can be natural or synthetic, it modifies or controls one or more specific physiological processes within a plant but the site of action and production are different.

What is Plant Growth Retardants?

These are synthetic compounds which reduce the growth of the plants. AMO-1618, Phosphon –D, CCC (Cycocel)-2 Chloro ethyl trimethyl ammonium Cloride, MH and B-995 are jasmonic acid, paclobutrazol important growth retardants.







JUST AGRICULTURE
multidisciplinary e-Newsletter

Auxins:

- **In Vivo:** Influence cell growth**,** stimulate root formation**,** induce vascular differentiation**,** promote tropic responses**,** maintain the apical dominance**,** induce the auxiliary buds, flowers, fruits.
- **In Vitro:** Induce callus, favors root and shoot morphogenesis, effective combined with cytokinins.

Gibberellins:

- **In Vivo:** Promote stem elongation, induce flowering, Cone initiation, Promote seed germination.
- **In Vitro:** Induce adventitious roots, can inhibit shoot formation, can inhibit root formation and can inhibit embryo formation.

Cytokinins

- **In Vivo:** Affect mitosis, promote lateral bud growth, Delay leaf senescence, promote chlorophyll synthesis, enhance chloroplast development**,** Promote leaf expansion.
- **In Vitro:** Stimulate cell division, release lateral bus dormancy, induce adventitious bud formation, can inhibit embryogenesis, can inhibit root formation.

Abscisic Acid:

- **In Vivo:** Regulates seed germination, induce storage protein synthesis, modulates water stress, maintains bud and seed dormancy, slows cell elongation, Modulates leaf abscission and senescence.
- **In Vitro:** Favors maturation of somatic embryos, Favors germination of somatic embryos, Increase freezing tolerance.

Ethylene:

- **In Vivo:** Promotes the development of root and shoots, promotes fruits ripening, promotes fruit senescence, Promote leaf abscission.
- **In vitro:** It's less frequently used, Promotes the maturation of tissues, affects stem elongation, affects root elongation, Affects bud formation.

PGRs and its examples

Growth Regulators	**Its examples**
Auxins	IAA, IBA, NAA, 2,4-D
Gibberellins	Gibberellic acid
Cytokinnins	Kinetine, Ziatene

JUST AGRICULTURE
multidisciplinary e-Newsletter

Ethylene	Ethylene
Dormins	Abscisic acid
Flowering Hormones	Florigen, Anthesine, Vernaline
Misllanious natural substances	Cyclitoles, Vitamines, Phytochromes, etc
Phinolic substances	Coumarine
Synthetic growth retardants	CCC, Phosphon D, Morphactines, Maeic Hydrazide, etc.
Misllanious synthetic substances	Synthetic Auxin, Synthetic Cytokinin

Important plant growth regulators with their trade names

Chemical Name	**Trade name**
Chloromequat chloride	Cycocel, CCC
2-chloroethyl phosphonic acid	Ethephon, Proxy, Ethrel, Prep, Mature
Gibberellic acid	GA_3, GA_7, Gib, Gro
Maleic hydrazide	Sucker stuff, Royal, Fair
Naphthalene acetic acid	Dipn, Grow. Hiyield
Paclobutrazole	PP_{333}, bonze, profile

Use of PGRs in fruit crops:

- Less number of flowers
- Flower drop
- Fruit drop
- Less number of seeds
- Hard seed coat
- Less plant growth rate
- Late maturity
- Less germination

PGRs used for fruit drop:

S.N.	**Fruits**	**Regulators**	**Effects**	**Features**
1	Mango	2,4-D 40 ppm	Reduction of fruit drop	6 weeks after fruit set
2	Citrus	2,4-D @ 20 ppm	To control pre-harvest flower drop	Kinnow mandarine

JUST AGRICULTURE
multidisciplinary e-Newsletter

3	Date palm	GA_3 and BA@ 100-150 ppm	Reduction of pre-harvest fruit drop	40-70 days after pollination
4	Litchi	Pre harvest drop	Pre harvest drop	After fruit set
5	Apple	Pre harvest drop	Pre harvest drop	7 days ahead of anticipated harvest
6	Litchi	GA_3 25 ppm and NAA 25 ppm	Fruit set	Full bloom stage
7	Apple	500 ppm GA_3	To increase the fruit set	
8	Mango	GA_3 25 ppm and NAA 25 ppm	Fruit set	Full bloom stage
9	Sapota	25-100 ppm NAA	For fruit set	At flowering
10	Citrus	NAA@100-500 ppm	Fruit thinning	Stage 1 fruit growth
11	Apple	Ethephone @ 100-300 ppm	Flower or fruit thinning	7–10-day petal falls
12	Peach	2.5 % thiourea, 5 % GA_3, Urea 4-6 %, Ethrel at 100-150 ppm	Fruit thinning	After fruit set
13	Mango (Malika cv)	Ethrel	500 ppm in hot water (54 ^{0}c +_1^{0}c) for 5 minutes	For fruit ripening and improve fruit quality
14	Banana	TBZ	200 ppm	For fruit ripening
15	Pineapple	Ethrel	2-4 kg/ha 3 weeks before harvest date	For fruit ripening at 10-15 days after application
16	Banana	Trifoliate	2500 ppm for 5 minutes	Enhanced storage life
17	Mandarin	Ethrel	1000 ppm At 24-28^0 C	Enhanced storage life
18	Mango	Benomyl	300 ppm for 10 minutes	Enhanced storage life

JUST AGRICULTURE
multidisciplinary e-Newsletter

19	Pineapple	Ethephone combination with (urea 2 %+ CaNa carbonate 0.04%)	Uniform flowering	March-May season
		NAA @10-20 ppm	Flower induction	Less effective
20	Mango	KNO_3 2 %	Flower manipulation	
21	Jackfruit	NAA @25 ppm	Improve germination	Seed soaking
22	Aonla	GA_3@500 ppm for 24 hrs	Enhanced seed germination	
23	Papaya	GA_3@200 ppm	Improve germination	Seed soaking
24	Pineapple (Kew)	MS medium- 1.5 ppm BAP+0.5 ppm NAA and 2.0 ppm BAP+0.25 ppm NAA	Slips apical section	Shooting
		2 ppm IBA and 1.5 ppm IBA + 0.5 ppm NAA		Rooting
25	Banana (*Musa sapientum* L.)	BAP and IAA (5.0 + 1.0 mg/l, respectively)	MS medium	Shooting
		IAA (2 mg/l)		Rooting
26	Allahabad Safeda	BAP 3.0 mg/l, IBA 10 mg/l	MS medium	3 cm long nodal segments
27	Ganesh	1.0 mg/1 BA + 0.5 mg/1 NAA, 0.5 mg/l IBA	Axillary shoot proliferation rooting	Shoot tip, nodal segment
28	Balwant	4.44 mg/l BAP+2.46 mg/l IBA	Shoot proliferstion	Nodal segments
29	Guava	NAA @200 ppm	Softwood cutting	With 2 nodes and 4 leaves
		3000 ppm IBA by pasting lanolin paste	Air layering	

JUST AGRICULTURE
multidisciplinary e-Newsletter

30	Pomegranate	IAA at 200 ppm	Hard wood cutting	Fully mature wood and 1 year old
		10000ppm IBA lanolin paste	Air layering	Fully mature wood and 1 year old
31	Litchi	10000ppm IBA+ ferulic acid	Semi+hard wood cutting	CV. Bombai
32	Jamun	IBA 1 % by pasting lanoline paste IBA 1000 ppm by quick dip method	In air layering, In cutting	Promote root
33	Mango, Grape, Sapota	IBA+BA (500+500ppm)	By grafting	Useful in joining the scion on root stock
34	Citrus, Ber, Jamun	IBA+BA (500:500 ppm)	Useful in bud joints	In budding
35	Mango	2000ppm	For reduction of tree height	CV tommy atkins
36	Apple	NAA at 1.5% in latex paint	For reduction rootstock suckers	
37	Grapes	CCC 500 ppm	Reduction of shoot growth	
38	Citrus	GA_3 @25 ppm and 50 ppm, 2,4-D @ 20 ppm	Flowering behavior and regulation	In acid line
39	Pomegranate	Application of GA_3 40 ppm	Fruit cracking	At maturity
40	Apple	NAA 5 mg/l	Improve fruit size and colour	
41	Grape	GA_3@10-40 ppm	Enlargement of panicle growth	
42	Papaya	GA_3 50 ppm	Increased femaleness	In co.1
43	Mango	NAA @200 ppm	Improve productivity of tree	In first week of October

JUST AGRICULTURE
multidisciplinary e-Newsletter

			affected by malformation	
44	Guava	NAD 50 mg	Increased fruit yield	By deblossoming the summer flower

Different method for the use of PGR:

- Use of hormones in powder form
- Use of hormones in liquid form
- Quick dip method
- Long dip method or slow method
- Use of hormones in paste form
- Use of hormones in vapour form
- Use of hormones in the form of Aerosol

Do's and Don'ts in use of growth regulators

- Growth substances should be psrayed preferably in afternoon
- Avoid spray in windy hours
- Spray should be uniform and rationally distribute on the foliage by ensuring wetting of both the surface of leaves
- Add surfactant or adhesive matrial like Teepole, Tween-20 or Gum with growth substances at an appropriate stage of plant growth
- Ensure uniform dissolving of chemical before use
- Always use fresh solution
- Always use distilled water for preparation of solution
- Fine sprays through hand atomizer can be more economical and effective
- Wash thoroughly the spraying equipment before and after each spray

Date palm:

Introduction:

- Botanical name: *Phoenix dactvlifera*, family: Arecaceae
- Originated probably from land around Iraq
- Cultivated in Egypt as early as 4000 BCE for wine
- In Arabia it was cultivated in 6000 BCE ago

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Evident shows that it was cultivated in Western Pakistan in 7000 BCE (Mehrgarh) Indus valley

- **Sowing, planting, growth**
  - Propagation is mostly done by suckers
  - Remove the earth from the base
  - Separate it very carefully from trunk
  - So that its root is not injured
  - Suitable age of suckers for transplanting: 2-3 years
  - Time of transplanting: Spring: Feb to Mar, Autumn: Sept/Oct
  - Time to start bearing: 4-5 years
  - Time to full production: 6-8 years
  - Normal economic bearing life: 50 years
  - Time of flowering: Feb to March
  - Time of harvest: Aug to Oct
  - Pits size is 75x75x75 cm
  - It should be prepared before 1 month of planting
  - Jan/Feb for spring & Aug/Sep for autumn planting
  - In orchards plant male tree in ratio of 1 male to 20 females for better pollination
  - Planting: Orchard planted on square system
  - Spacing: Tree spaced as 6 x 6 m or 112 trees/acre
  - Intercropping:
  - Date palms are tall trees they have enough inter spacing between them
  - It is possible to grow a mixed orchard

Example:

- Date intercropped with citrus
- Field crops such as fodder and vegetable may also be grown

Use of PGRs in date palm

In propagation:

- Seeds treated with GA_3 at 100 ppm exhibited better seedling growth with higher germination percentage, number of leaves per plant, number of roots per plant and root length.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- NAA improved rooting in ground offshoots and is also essential for good root formation in aerial offshoots.
- 2,4-dichlorophenoxyacetic acid (2,4-D) as the most efficient auxin to induce embryogenic callus at 100 mg L-1 concentration in date palm.
- An application of GA_3, the size of midrib increased along with number of vascular bundles.
- Application of NAA at high concentration along with high saline water prevented a reduction in mineral nutrients. Furthermore, it increased the concentration of Na, Cl, N, P, Ca and Mg in roots. Moreover, seedlings treated with NAA in saline affected irrigation water did not show any symptom
- Inflorescence pollinated with pollen having higher level of IAA and GA_3 in initial stage exhibited better growth and fruit size with larger fruit weight at later stages, which represents the influence of metaxenia.
- Freshly opened clusters were sprayed with Indole acetic acid (10 ppm), Gibberellic acid (10 ppm), 6-Furfurylaminopurine plus gibberellic acid (10 ppm). Results indicated that growth regulators applied significantly increased the fruit weight, fruit length and formation of seedless fruits.
- Application of NAA alone or in combination with GA_3 and ethephon reduced fruit dry matter percentage and ripening. However, it increased the fruit flesh percentage and production per bunch and per tree.
- The relative effectiveness of GA_3 (150 gm L-1), NAA (100 gm L-1), ethephon (1000 gm L-1) and a combination of these growth regulators on some fruit characteristics and fruit yield of date palm.
- Concluded that GA_3 and BA at a concentration of 150 ppm gave the highest yield with the best quality and fruit characteristics.
- BA treatments with low concentrations of auxin and GA_3 were suitable for improvement in quantity and quality traits of ‘Shahani’ date fruits.
- The application of 10 mg/L 6-phurphuril amino purin + GA_3 on pollinated clusters of three date cultivars (‘Simbebel’, ‘Talis’ and ‘Edvi’) significantly increased fruit weight and length and produced seedless fruits.
- Significantly higher bunch weight, fruit weight, flesh weight and TSS were recorded by the application of NAA at 60, 80 and 100 ppm.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Spray of 1000 ppm ethephon at colour break stage was thus found beneficial for uniform maturity, ripening and production of better quality fruits in date palm (Meena et al., 2013).
- GA_3 spray on date palm fruits has been reported to improve fruit size and quality (Hussein et al., 1996; Moustafa and Seif, 1996; Moustafa et al., 1996);
- In the first method, 2 ml of ethrel was injected by making a small pit on the peduncle and covered by a cellotape. In the second method, 1000 ppm ethrel was sprayed on the fruit bunches. There was significant increase in fruit ripening especially by the first method.
- Combination of GA_3 (100 ppm) and NOA (100 ppm) growth regulators, when sprayed on unpollinated clusters, produced normal size seedless fruits that were late in ripening.
- Generally, treatments having BA with low concentrations of auxin and GA_3 were suitable for improvement of quantity and quality traits of 'Shahani' date fruits.
- Role of PGRs on Post Harvest Management Internationally, dates are harvested at the Khalal, Rutab and Tamar stage depending on the variety, agroclimate and market demand.
- The degree of perishability decreases from KhalalRutab-Tamar. In India, dates are harvested at the Khalal stage also known as Doka stage to avoid damage by rainfall. Keeping in mind the demand by consumers and to avoid losses caused by rainfall, researchers have attempted to hasten or delay ripening in date palm utilizing PGRs.
- Generally, treatments having BA with low concentrations of auxin and GA_3 were suitable for improvement of quantity and quality traits of 'Shahani' date fruits.
- The results indicated that, the treatment with growth regulators significantly increased the weight of the fruit, length of the fruit of the fruit and then the formation of seedless fruits.
- The number of fruitset was also increased. The varieties responded differently to each growth regulator.

References:

Kumari, S., Bakshi, P., Sharma, A., Wali, V., Jasrotia, A. & Kour, S. (2018). Use of Plant Growth Regulators for Improving Fruit Production in Sub Tropical Crops. *International Journal of Current Microbiology and Applied Sciences.*7.659-668. 10.20546/ijcmas.2018.703.077.

Suman, M., Sangma, P. D., Meghawal, D. R. & Sahu, O. P. (2017). Effect of plant growth regulators on fruit crop. *Journal of Pharmacognosy and Phytochemistry.***6**(2): 331-337.

TNAU Agritech Portal, Agriculture, Plant Nutrition: Plant Gowth Regulators.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Elmaataoui S, Mazri MA, Meziani R, Bouchiha F, Anjarne M and Alfeddy MN. (2020). Optimization of auxin-cytokinin combination for rapid proliferation of adventitious buds of date palm cv. Aziza Bouzid. GSC Biological and Pharmaceutical Sciences, 11(1), 01-08.

Shama, K.M., Ahlawat, T.R., Murlidharan, C. M., Suchismita, J and Patel, D. (2019). Plant Growth Regulators in Date Palm. PGRs in Tropical and Subtropical fruit crops. 10, 164-186.