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Effect of NAA, GA_3, kinetin and ethrel on yield and quality in phalsa (*Grewia sub-inaequalis* DC)

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Abstract : A field experiment was carried out during 2009-2010 in Model Orchard at College of Horticulture, Rajendranagar, Hyderabad to assess the influence of NAA 25 and 50 ppm, GA_3 50 and 100 ppm, kinetin 15 and 50 ppm, ethrel 250 and 500 ppm on yield and quality parameters of phalsa (*Grewia sub-inaequalis* DC)". Among all the treatments, GA_3 100 ppm was most effective in improving yield per plant (3.05 kg), yield per hectare (7.63 t ha^{-1}) and hundred fruit weight (61.48g). Ethrel 500 ppm recorded maximum total soluble solids content (25.72 %). Maximum reducing sugar (18.91%), TSS to acid ratio (10.98), pulp weight (51.45g), pulp to stone ratio (5.85g) and minimum titratable acidity (2.26 %) and stone weight (8.83g) was recorded with GA_3 100 ppm. Kinetin 30 ppm recorded maximum shelf life (51.46 hr) of the fruits.

Key words : Phalsa, Plant growth regulators, Yield, Quality, Shelf life

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Phalsa (*Grewia sub-inaequalis* DC) belongs to the family Tiliaceae is one of the hardy tropical and subtropical fruit plant, withstand drought and grown under adverse climatic conditions. The ripe phalsa fruits are consumed fresh, as desserts or processed into refreshing fruit and soft drinks enjoyed during summer months in India (Salunkhe and Desai, 1984). The fruits are excellent for processing into quality beverages, ready to serve, nectar, syrup and squash.

Application of growth substances *viz.*, auxins and gibberellins has been effective in increasing fruitset and yield in several fruit crops including phalsa (Randhawa *et al.*, 1959). Application of GA_3 results in increased yield and better grade phalsa fruits (Randhawa *et al.*, 1967). Ethrel sprayed at full bloom stage found to be increasing TSS content of the phalsa fruits (Rema and Sharma, 1991) and efficacy of kinetin in increasing shelf life by reducing the physiological loss of weight of fruit crops was shown by various workers (Dedolph *et al.*, 1961: Randhawa *et al.*, 1976).

RESEARCH METHODS

A field experiment was conducted in Model Orchard at College of Horticulture, Rajendranagar, Hyderabad on healthy phalsa bushes during 2009-2010. The experiment was laid out in a Randomized Block Design with nine treatments and replicated thrice. The treatments consisted of two levels each of naphthalene acetic acid 25 and 50 ppm, gibberellic acid 50 and 100 ppm, kinetin 15 and 50 ppm, ethrel 250 and 500 ppm and control. The growth regulators were applied twice *i.e.*, first spray at pre bloom and second spray at post bloom stage.

Data was recorded on fruit weight and yield characters and chemical analysis was done to determine quality parameters of the fruit. The weight of the fruits was recorded in grams taking a random sample of 100 fruits from the harvest of each treated bush using a YAMATO balance.TSS was determined by hand refractometer and acidity was estimated as per the method of Ranganna (1986). Reducing sugars were estimated by Fehling's method using methylene blue as

indicator and expressed in terms of percentage (A.O.A.C. 1980). Pulp weight and stone weight based on 100 fruit weight and sixty per cent of fruits spoilage considered as the end of shelf life and the time (hrs) was recorded.

RESEARCH FINDINGS AND DISCUSSION

Among the different growth regulators applied maximum 100 fruit weight (61.48g) sprayed with GA_3 at 100 ppm followed by GA_3 at 50 ppm (59.33g) shown in the Table 1. Minimum was recorded with NAA at 50 ppm (54.12g) and control recorded a weight of (57.14g). Similarly, (Reddy, 1977) and (Prasad, 1990) reported that fruit weight was increased due to GA_3 sprays in phalsa, Al-Dujaili *et al*. (1987) and Hallbrooks and Mortenson, 1988) in grapes. The beneficial effect of GA_3 in increasing fruit weight seems to be through enhanced mobilization of food reserves (Nanda and Purohit, 1965). The reduction in the fruit weight was maximum with NAA 50 ppm, which may be due to very high fruit set resulting in competition among the developing fruitlets for food. The results obtained in respect of NAA are also in agreement with the findings of Reddy (1977) who reported that celemone sprays (NAA) did not increase fruit weight in phalsa. Prasad (1990) reported reduction in fruit weight due to NAA application which is in conformity to the present findings.

Bushes treated with GA_3 at 100 ppm produced significantly more yield (3.05 kg/plant) and less yield was recorded with ethrel 500 ppm 0.645 kg/plant. Yield recorded with NAA 25 ppm (2.76 kg/plant) was at par with GA_3 at 50 ppm (2.88 kg/plant) but significantly superior over kinetin 15 ppm (2.34kg/plant) and kinetin 30 ppm (2.38kg/plant) which in turn at par with each other. The increase in the yield due to GA_3 treatment is due to increase in fruit set and fruit weight. The higher fruit yield might be due to GA_3 mediating process for faster translocation and mobilization of stored metabolites or photosynthates from source points (Singh *et al*., 2003). Increased yield due to GA_3 application of phalsa was also reported by Randhawa *et al*. (1959); Singh *et al*. (1966); Reddy (1977); Moti Singh (1986) (Fig. 1).

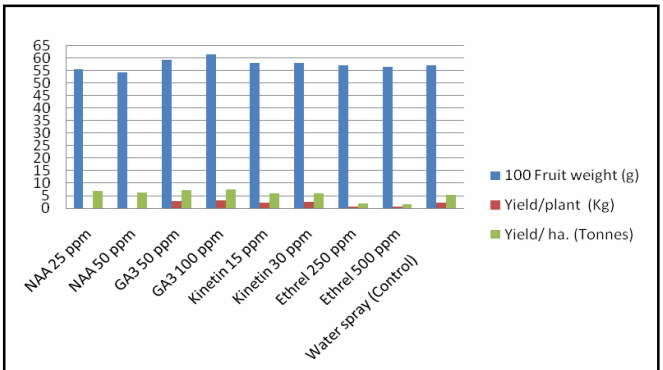

Fig. 1 : Effect of growth regulators on yield parameters in phalsa

Significantly higher content of TSS was obtained when the bushes were sprayed with ethrel 500 ppm (25.72 %) followed by ethrel 250 ppm (25.10%) and minimum was recorded in control (19.80%). Increased in the TSS by ethrel may be due to quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from the leaves to the developing fruits (Tripathi and Sukhla, 2007). Similar finding was also reported by Rema and Sharma (1991 in phalsa.

Highest GA_3 treatment at 100 ppm was more effective in reducing acidity (2.26%) when compared to control (2.55%). Lower acidity (2.34%) was recorded with ethrel 250 ppm which was at par with higher

Table 1: Effect of growth regulators on yield and quality in phalsa (Grewia sub-inaequalis DC)

Treatments	100 fruit weight (g)	Yield/ plant (kg)	Yield/ ha (Tonnes)	T.S.S (%)	Titratable acidity (%)	Reducing sugars (%)	TSS: acidity	Pulp weight (100 fruits) (g)	Stone weight (100 fruits) (g)	pulp: stone ratio	Shelf life (h)
NAA 25 ppm	55.51	2. 76	6.89	23.05	2.45	18.52	9.41	47.57	9.12	5.22	43.11
NAA 50 ppm	54.12	2. 56	6.40	21.68	2.44	18.46	8.87	46.26	9.65	4.79	44.50
GA3 50 ppm	59.33	2.88	7.25	24.31	2.33	18.71	10.43	50.78	9.38	5.41	46.52
GA3 100 ppm	61.48	3.05	7.63	24.83	2.26	18.91	10.98	51.45	8.83	5.85	48.40
Kinetin 15 ppm	57.89	2.34	5.85	20.56	2.48	18.34	8.28	43.31	10.35	4.18	49.38
Kinetin 30 ppm	58.03	2.38	5.95	21.04	2.46	18.40	8.56	44.10	10.10	4.26	51.46
Ethrel 250 ppm	57.08	0.784	1.95	25.10	2.33	18.67	10.73	43.14	10.41	4.36	41.08
Ethrel 500 ppm	56.40	0.645	1.60	25.72	2.40	18.79	10.72	42.52	10.52	4.04	39.53
Water spray (Control)	57.14	2.16	5.24	19.80	2.55	18.25	7.77	40.25	10.81	3.71	36.12
S.E. ±	0.20	0.05	0.11	0.10	0.02	0.01	0.11	0.39	0.03	0.05	0.43
C.D. (P=0.05)	0.60	0.15	0.33	0.31	0.06	0.05	0.32	1.18	0.08	0.14	1.30

concentration ethrel 500 ppm (2.40%). The acidity of the fruit under the influence of growth regulators applied declined because it might have converted fastly into sugar and their derivatives (Koruna *et al*., 2007) or due to faster degradation of organic acids (Dutta *et al*., 2008). Prasad (1990) also reported similar results with GA_3 in phalsa and Sharma and Dhillon (1984) in litchi.

Maximum content of reducing sugars (18.91 %) was observed with GA_3 at 100 ppm followed by ethrel 500 ppm (18.79 %). The content of reducing sugars was higher with of GA_3. Increased in reducing sugar with higher concentration of GA_3 was reported by Prasad (1990) in phalsa and Phaniprasasd (1980) in guava, Thilak (1980) in Thompson Seedless grapes. Gibberellins have been shown to act through auxin synthesis hence, the exogenous application of GA_3 might have supplemented the endogenous auxin and causes greater influx of sugars in the fruits (Mohammed and Hulamani, 2001). Reducing sugar per cent age (18.67 %) was also improved with 500 ppm ethrel in phalsa. Present finding was confirmed with the findings of Rema *et al*. (1993) with ethrel in phalsa.

Maximum TSS: acidity ratio (10.98 %) was observed with GA_3 100 ppm followed by ethrel 250 ppm (10.73%). This might be due to early and rapid degradation of acid and its conversion into sugars (Koruna *et al*., 2007). This is in conformity with the findings of Thilak (1980) in Thompson seedless and Mohammed and Hulamani (2001) in Arkavati grapes.

Bushes treated with GA_3 at 100 ppm produced significantly higher pulp weight (51.45g/100 fruits) over other treatments followed by GA_3 at 50 ppm (50.78g/100 fruits) but were at par with each other. On the other hand, minimum pulp weight was recorded (40.25g/100 fruits) in control. The increase in the pulp weight may be due to the cell multiplication and cell enlargement or may be enhanced uptake of water and accumulation of sugar and other food reserves in greater amount as well as increased volume of intercellular spaces in the pulp of fruit due to GA_3. This finding substantiate the earlier reports on this aspects by Khan *et al*. (1976) and Singh and Lal (1980) in litchi, Ruby Rani and Brahmachari (2004) in mango and Prasad and Bajpai (1963) who also observed similar responses of phalsa with the fruits application of GA_3.

Bushes treated with GA_3 at 100 ppm produced significantly minimum stone weight (8.83g) and maximum stone weight was recorded (10.81g) in control. GA_3 were found effective in producing parthenocarpic fruits in multiseeded fruits but in single seeded fruits they reduced the size and weight of the seed Sharma and Dhillon, (1984).These results are in agreement with the findings of Rao and Rao (1963) in phalsa, Islam and Siddique (1973) in guava and Sharma and Dhillon (1984) in litchi.

Bushes treated with GA_3 at 100 ppm produced significantly higher pulp to stone ratio (5.85) followed by GA_3 at 50 ppm (5.41). On the other hand, less pulp to stone ratio was recorded (3.71) in control.Highest shelf life (51.46 hr) was recorded with kinetin 30 ppm which was significantly superior to other treatments followed by kinetin 15 ppm (49.38 hr) and least shelf life was rescored in control (36.12 hr). The increased in the shelf life due to kinetin application may be attributed to efficacy of kinetin to increase endogenous kinins, stimulates protein synthesis as well as nucleic acid synthesis thereby delaying the senescence and reduce the physiological loss of weight during storage. Similar results were reported by earlier worker in grapes (Dedolph *et al*., 1961; Randhawa *et al*., 1976; Dhillon, 1985; Mir *et al*., 1996 in apple). GA_3 treatments also improved the shelf life (Fig. 2).

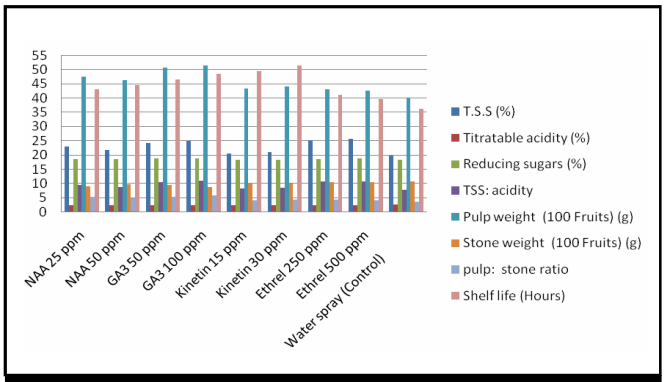

Fig. 2 : Effect of growth regulators on quality parameters in phalsa

Conclusion:

Application of GA_3 100 ppm was found to be good for increasing the yields and improve quality of phalsa fruits under the agro-climatic conditions of Hyderabad. The next better treatment was GA_3 50 ppm followed by NAA 25 ppm to increase yield and improve quality of phalsa.

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