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Effect of GA_3 and Urea spray on flowering,fruiting and quality of mango (*Mangifera indica* L.) cv. Langra

Lata Patel*, Rajesh Tiwari*,* Rajesh Jatav and Narendra Vasure****

***** Jawaharlal Nehru Krishi Vishwa Vidyalaya Jabalpur, M.P.
******Rajmata Vijayaraje Scindia Agricultural University, Gwalior, M.P.

E-Mail: rajeshjatavhorti@gmail.com

ABSTRACT:

An experiment was conducted to find out effect of GA_3 and Urea spray on flowering, fruiting and quality of mango cv. Langra. In this investigation nine treatments combination of GA_3 (10 ppm and 20 ppm) and Urea (2 % and 4 %) were imposed in different concentration and their combination, each treatment was replicated three times. Spraying of GA_3 at 10 ppm along with 2% urea spray proved the best for the phenological parameters. In flowering behavior, the number of male and hermaphrodite flowers did not change upto significant extent due to different concentrations of GA3 and urea spray on Langra mango. Among the productivity parameters Spraying of GA_3 at 10 and 20ppm increased equally the number of fruits as well as equally increased the fruit yield (47.10to 44.83 q/ha), being significantly superior to without GA_3 spray. Urea spray with 2% brought about significantly higher number of fruits over the lowest urea concentrations. Physical parameters *viz*; average weight of fruit, length and width of mango fruits significantly influenced by spraying of GA_3. Chemical parameters viz; total sugars, reducing and non-reducing did not change due to GA3 and urea spray treatments.Urea spray upto 2% recorded significantly higher TSS and significantly lowest acidity. On the other hand, the reverse trend was obtained at 4% urea where TSS was significantly lowest and the acidity was significantly highest.

KEYWORDS: TSS, GA3, Spraying, Significantly

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INTRODUCTION :

Mango (*Mangifera indica* L.) is considered to be the number one fruit of India which is nutritionally superior and one of the most valuable fruits of the world. It belongs to family Anacardiaceae and has 2n=40 chromosome number. Fruits of mango predominate in water, carbohydrates, organic acids, fats, minerals, pigments, tannin, and vitamin. The ripe fruits pulp contains about 11.8 carbohydrates, 4800 IU of vitamin A and 13 mg/100ascorbic acid. The pulp is a rich source of ß carotene; sucrose, glucose and fructose constitute the bulk of carbohydrates and most of the soluble solids in mango pulp.

Mango is produced throughout the world especially in the countries like Philippines, Indonesia. Thailand, Burma, Malaya, Shrilanka, Egypt, South East Africa, Israel, Tropical Australia, USA (Howaii and Florida). Though mango is cultivated in almost all the states of India, Uttar Pradesh, Bihar and Andhra Pradesh are the leading ones both in area and production. Other states where mango cultivation exists includes Orissa, West Bengal, Karnatka, Gujarat, Maharashtra, Madhya Pradesh, Tamil Nadu, Kerala and Punjab.

In India, the area of mango is 2.97 lakh ha. with production 21.38 MT and productivity 7.19 tons/ha.in 2018-19 (National Horticulture Board 2018-19). In which Madhya Pradesh occupies an area 49568.8 thousand hectare and production is 704067.05 thousand metric tonnes and productivity 14.20 MT/hectare (Data base DOH & FP Govt. of M.P. 2018-19).

The foliar application of macro-nutrients and plant growth regulators have very important role in improving the productivity and quality of fruits. It has also beneficial role in recovery of nutritional and physiological disorders in fruit trees. Earlier studies conducted on foliar spray of macro-nutrients and plant growth regulators in different fruit species shown significant response to improving yield and quality of fruits. Due to tremendous increase in population and increased demand it is essential to improve the production with the available resources. The low productivity of mango in India can be attributed to poor orchard management, dense canopies with wider spacing, poor

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sunlight interception and ventilation encouraging more pest and disease incidence (Kumar, 2019).Irregular or erratic flowering, low fruit set as well as fruit retention leading to low yield and fruits of poor quality and short availability period are also the main problems in mango production. Spraying of GA_3 significantly increased the percentage of flowering shoots and the number of mixed panicle and vegetative shoots/auxilary branches (Rojas *et al.,* 1993). Foliar spraying of Urea significantly increased the flowering percentage of mango (Rajput and Singh, 1988; Catchpoole and Bally, 1993). Sharma *et al.* (1990) obtained maximum number of fruits per plant and fruit weight of mango cv. Langra at Madhya Pradesh, India from the Urea treatment. Gupta and Brahmachari (2004) found maximum yield using Urea. The present study was aimed at investigating the effects of $GA_3$and Urea on flowering, fruiting, yield as well as quality attributes of mango.

MATERIAL AND METHODS:

Experimental Location:

The experiment was conducted in mango orchard of Fruit Research Station Kuthulia, College of Agriculture, Rewa (M.P.) and the chemical analysis of the fruits was done in the laboratory of the Department of Soil Science, College of Agriculture, Rewa (M.P.) during the winter season in the year of 2020-2021.

Climate and weather conditions:

Rewa is situated in the North Eastern part of Madhya Pradesh at latitude 24.031o N, longitude 81.015 o E and altitude 365.7 meters above the mean sea level. Rewa enjoys the subtropical climate. Hot and dry summer and cold winter are the main characteristic features of the region. In general the maximum and minimum temperature goes above 43.30oC and below 50oC respectively. The average rainfall varies from 900 mm to 1150 mm which is received mainly rainy season.

Experimental details:

Fifteen year old plants of mango cv. Langra spaced 10 m x 10 m apart at Fruit Research Station Kuthulia, Rewa were selected for the study. One plant considering as a unit was replicated 3 times in a randomized block design. There was spraying of GA_3 and Urea combination and stages of spraying having nine and one levels respectively GA_3 (0, 10, 20ppm) and urea (0%, 2%, 4%) GA_3 0 ppm and urea 0% as a control were sprayed at 50% flowering stage. Fruits were harvested on 25th June 2021 and stored at ambient

temperature. In stage, fruit were placed in a single layer on the floor. Observation on phenological parameters, physical parameters and chemical parameterwere recorded. The data were statistically analysed by the method given by Panse and sukhatme (1963).

RESULTS AND DISCUSSION:

Phenological parameters

Data presented table 1, revealed that spray of GA_3 20 ppm with 4% urea was proved best whereas the date of first appearance of flowering was earliest on 19 January. It became late (23 to 24 January) when GA_3 20 ppm was applied with 0 or 2% urea as spray. The first appearance of flowering was further become late when urea was applied in different concentrations without GA_3 (25 to 26 January). GA_3 10 ppm with different percentage of urea resulted in the intermediate dates (20 to 21 January).

The similar result was also observed in case of date of 50% flowering. The 50% flowering occurred on 19 February when GA_3 20 ppm was applied with 4% urea. It was delayed when GA_3 20ppm was applied with 0 and 2% urea (24 to 27 February). The 50% flowering was further delayed when different concentrations (0 and 2%) of urea were applied without GA_3 (23 to 28 February). GA_3 10 ppm applied with each of the urea concentrations resulted in the intermediate dates (21 to 23 February).

Consequently the dates of full bloom of flowering in different treatments occurred accordingly. Earliest full bloom of flowering appeared on 9 March in the same treatment having GA_3 20 ppm with 4% urea. This was followed by GA_3 10ppm with different concentrations of urea (10 to 13 March) or GA_3 20 ppm with 0 and 2% urea spray (12 to 13 Mach). The full bloom of flowering was further delayed in 13 to 18 March when different concentrations of urea were applied without GA_3.

Table 1: Phonological parameters of Langra mango as influenced by GA_3 and urea spray.

S. No.	Treatment combinations	Date of first appearance of flowering	Date of 50% flowering	Date of full bloom of flowering
1	GA_0 (ppm) Urea 0%	26 January	28 February	18 March
2	GA_0 (ppm) Urea 2%	22 January	24 February	13 March
3	GA_0 (ppm) Urea 4%	25 January	27 February	16 March
4	GA_{10} (ppm) Urea 0%	20 January	23 February	13 March
5	GA_{10} (ppm) Urea 2%	20 January	21 February	10 March
6	GA_{10} (ppm) Urea 4%	21 January	23 February	11 March
7	GA_{20} (ppm) Urea 0%	23 January	24 February	12 March

8	GA_{20} (ppm) Urea 2%	24 January	27 February	13 March
9	GA_{20} (ppm) Urea 4%	19 January	19 February	9 March

Flowering Behaviour:

Numbers of male flowers/panicle

Numbers of male flowers/panicle were recorded in each treatment combination. The data after statistical analyses are highlighted in Table 2. The perusal of data indicated that there were no any significant changes in the number of male flowers due to different concentrations of GA_3 and urea spray on Langra mango. However, it is interesting to note that such flowers were decreased/panicle non-significantly when GA_3 was sprayed up to 20 ppm, whereas such flowers were increased non-significantly when urea was sprayed up to 4%.

Table 2: Combined effect of GA_3 and urea on No. of male flowers per panicle of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean U
U_0	270.21	278.08	261.11	269.80
U_1	272.68	280.67	262.85	272.07
U_2	265.82	275.76	257.48	266.35
Mean G	269.57	278.17	260.48	

Factors	C.D.	SEm±
Factor(U)	N/S	4.81
Factor(G)	N/S	4.81
Factor(U X G)	N/S	8.34

Number of hermaphrodite flowers

Numbers of hermaphrodite flowers were recorded in each treatment combination. The data after statistical analyses are highlighted in Table 3. The perusal of data revealed that there were no any significant changes in the number of hermaphrodite flowers due to different concentrations of GA_3 and urea spray on Langra mango. However, it is interesting to note that such flowers were decreased/panicle non-significantly when GA_3 was sprayed upto 20 ppm and urea was sprayed up to 4%.

Table 3: Combined effect of GA_3 and urea on No. of hermaphrodite flowers per panicle of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	493.67	501.55	480.15	491.79
U_1	497.10	503.14	485.77	495.33
U_2	490.17	499.98	471.67	487.27
Mean B	493.64	501.55	479.19	

Factors	C.D.	SEm±
Factor(U)	NS	11.11
Factor(G)	NS	11.11
Factor(U X G)	NS	19.25

Total Number of flowers per panicle

Total Number of flowers per panicle were recorded in each treatment combination. The data after statistical analyses are highlighted in Table 4. Accordingly, the total number of flowers at 20ppm GA_3 were lower (720.31/ panicle) as against higher (745.01/panicle) at 10ppm GA_3. In case of urea spray, total flowers at 2% urea were higher (737.51 flowers/panicle) as against lower (728.24/panicle) at 0% urea spray. The treatment interactions were found to be non-significant.

Table 4: Combined effect of GA_3 and urea on Total No. of flowers per panicle of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	729.14	739.15	716.44	728.24
U_1	737.64	750.54	724.37	737.51
U_2	733.94	745.34	720.12	733.13
Mean B	733.57	745.01	720.31	

Factors	C.D.	SEm±
Factor(U)	NS	11.11
Factor(G)	NS	11.11
Factor(U X G)	NS	19.25

Physical parameters

Average weight of fruit (gm)

The average weight of fruit (gm) was recorded in each treatment combination. The data after statistical analyses are highlighted in Table 5. The average weight of fruit (gm) was recorded with the GA_3 and Urea spray and their combinations. Among the

treatments, the treatment G_1 (220.63 gm) gave significantly superior to other treatment *i.e.*G_0 (217.08 gm) and G_2 (212.51 gm). Whereas, Urea spray (U_1) gave maximum Average weight of fruit (218.12 gm) and the (U_2) minimum Average weight of fruit (215.10 gm) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 5: Combined effects of GA_3 and urea on Average weight of fruit (gm) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	217.23	220.55	213.24	217.00
U_1	218.10	222.14	214.12	218.12
U_2	215.93	219.20	210.19	215.10
Mean B	217.08	220.63	212.51	

Factors	C.D.	SEm±
Factor(U)	2.35	0.78
Factor(G)	2.35	0.78
Factor(U X G)	NS	1.35

Length of fruit (cm)

The length of fruit (cm) was recorded in each treatment combination. The data after statistical analyses are highlighted in Table 6. The length of fruit (cm) was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (10.89 cm) gave significantly superior to other treatment i.e. G_0 (10.27 cm) and G_2 (9.56 cm). Where Urea spray (U_1) gave maximum Length of fruit (10.48 cm) and the (U_2) minimum Length of fruit (9.98 cm) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 6: Combined effects of GA_3 and urea on Length of fruit (cm) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	10.23	10.91	9.65	10.26
U_1	10.56	11.04	9.84	10.48
U_2	10.04	10.72	9.19	9.98
Mean B	10.27	10.89	9.56	

Factors	C.D.	SEm±
Factor(U)	0.34	0.11
Factor(G)	0.34	0.11
Factor(U X G)	NS	0.19

Width of fruit (cm)

Data on the width of fruit (cm) was recorded in each treatment combination and statistical analyses are highlighted in Table 7. The width of fruit (cm) was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (6.39 cm) gave significantly superior to other treatment i.e. G_0 (5.93 cm) and G_2 (5.39 cm). Where Urea spray (U_1) gave maximum Width of fruit (6.01 cm) and the (U_2) minimum Width of fruit (5.78 cm) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 7: Combined effects of GA_3 and urea on Width of fruit (cm) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	5.95	6.40	5.41	5.92
U_1	6.06	6.54	5.45	6.01
U_2	5.79	6.23	5.32	5.78
Mean B	5.93	6.39	5.39	

Factors	C.D.	SEm±
Factor(U)	0.07	0.02
Factor(G)	0.07	0.02
Factor (U X G)	NS	0.04

Yield (Kg/Tree)

Data on the yield (Kg/Tree) was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (47.10 kg) gave significantly superior to other treatment i.e. G_0 (46.01 kg) and G_2 (44.83 kg). Where Urea spray (U_1) gave maximum Yield (Kg/Tree) (46.27 kg) and the (U_2) minimum Yield (Kg/Tree) (45.61 kg) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant Table 8.

Table 8: Combined effects of GA_3 and urea on Yield (Kg/Tree) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	46.22	47.12	44.84	46.06
U_1	46.65	47.25	44.92	46.27
U_2	45.18	46.94	44.73	45.61
Mean B	46.01	47.10	44.83	

Factors	C.D.	SEm±
Factor(U)	0.47	0.15
Factor(G)	0.47	0.15
Factor(U X G)	NS	0.27

Specific gravity

The specific gravity was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (1.05) gave significantly superior to other treatment i.e. G_0 (0.98) and G_2 (0.90). Where Urea spray (U_1) gave maximum Specific gravity (1.00) and the (U_2) minimum Specific gravity (0.95) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant (Table 9).

Table 9: Combined effect of GA_3 and urea on Specific gravity of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	0.99	1.05	0.91	0.98
U_1	1.01	1.07	0.93	1.00
U_2	0.96	1.03	0.87	0.95
Mean B	0.98	1.05	0.90	

Factors	C.D.	SEm±
Factor(U)	0.03	0.01
Factor(G)	0.03	0.01
Factor(U X G)	NS	0.02

Pulp percentage

The pulp percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (74.02 %) gave significantly superior to other treatment i.e. G_0 (72.91 %) and G_2 (71.77 %). Where Urea spray (U_1) gave maximum Pulp percentage (73.22 %) and the (U_2) minimum Pulp percentage (72.57 %) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant (Table 10).

Table 10: Combined effect of GA_3 and urea on Pulp percentage of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	72.93	73.97	71.83	72.91
U_1	73.12	74.47	72.08	73.22
U_2	72.70	73.63	71.40	72.57
Mean B	72.91	74.02	71.77	

Factors	C.D.	SEm±
Factor(U)	0.39	0.13
Factor(G)	0.39	0.13
Factor(U X G)	NS	0.22

Peel percentage

The peel percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (16.91 %) gave significantly superior to other treatment i.e. G_0 (15.97 %) and G_2 (14.91 %). Where Urea spray (U_1) gave maximum Peel percentage (16.13 %) and the (U_2) minimum Peel percentage (15.68 %) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant (Table 11).

Table 11: Combined effect of GA_3 and urea on Peel percentage of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	15.99	16.95	15.00	15.98
U_1	16.21	17.08	15.12	16.13
U_2	15.71	16.72	14.62	15.68
Mean B	15.97	16.91	14.91	

Factors	C.D.	SEm±
Factor(U)	0.34	0.11
Factor(G)	0.34	0.11
Factor(U X G)	NS	0.19

Stone percentage

The stone percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (12.07 %) gave significantly superior to other treatment i.e. G_0 (11.40 %) and G_2 (10.62 %). Where Urea spray (U_1) gave maximum Stone percentage (11.57 %) and the (U_2) minimum Stone percentage (11.17 %) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 12: Combined effect of GA_3 and urea on Stone percentage of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	11.38	12.06	10.63	11.35
U_1	11.61	12.31	10.79	11.57
U_2	11.21	11.85	10.45	11.17
Mean B	11.40	12.07	10.62	

Factors	C.D.	SEm±
Factor(U)	0.06	0.02
Factor(G)	0.06	0.02
Factor(U X G)	NS	0.04

Chemical parameters:

T.S.S. (^{0}Brix)

The T.S.S. (^{0}Brix) was recorded in each treatment combination. The data after statistical analyses are highlighted in Table 13. The T.S.S. (^{0}Brix) percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (22.98) gave significantly superior to other treatment i.e. G_0 (22.17) and G_2 (21.13). Where Urea spray (U_1) gave maximum T.S.S. (22.39) and the (U_2) minimum T.S.S. (22.39) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 13: Combined effect of GA_3 and urea on T.S.S of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	22.12	22.97	21.12	22.07
U_1	22.49	23.14	21.55	22.39
U_2	21.92	22.84	20.74	21.83
Mean B	22.17	22.98	21.13	

Factors	C.D.	SEm±
Factor(U)	0.34	0.11
Factor(G)	0.34	0.11
Factor(U X G)	NS	0.19

Acidity Percentage:

The acidity percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (0.22%) gave significantly superior to other treatment *i.e.*G_0 (0.27 %) and G_2 (0.31%). Where Urea spray (U_1) gave minimum Acidity percentage (0.26%) and the (U_2) maximum Acidity percentage (0.28%) found superior to other treatments. The interactions of GA_3 and Urea spray were non-significant (**Table 14)**.

Table 14: Combined effect of GA_3 and urea on Acidity % of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	0.27	0.23	0.31	0.27
U_1	0.26	0.21	0.31	0.26
U_2	0.29	0.24	0.32	0.28
Mean B	0.27	0.22	0.31	

Factors	C.D.	SEm±
Factor(U)	0.03	0.01
Factor(G)	0.03	0.01
Factor(U X G)	NS	0.02

Reducing sugar Percentage:

The reducing sugar percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (6.73%) gave significantly superior to other treatment i.e. G_0 (6.67%) and G_2 (6.35%). Where Urea spray (U_1) gave maximum reducing sugar percentage (6.77%) and the (U_2) minimum Reducing sugar percentage (6.55%) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 15: Combined effects of GA_3 and urea on reducing sugar % (Burette) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	6.71	6.27	6.34	6.44
U_1	6.77	7.12	6.42	6.77
U_2	6.54	6.82	6.31	6.55
Mean B	6.67	6.73	6.35	

Factors	C.D.	SEm±
Factor(U)	0.26	0.09
Factor(G)	0.26	0.09
Factor(U X G)	NS	0.15

Non-reducing sugar Percentage:

The non-reducing sugar percentage was recorded in each treatment combination. The data after statistical analyses are highlighted in Table 16. The non-reducing sugar percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (11.01%) gave significantly superior to other treatment i.e. G_0 (10.65 %) and G_2 (10.24%). Where Urea spray (U_1) gave maximum non-reducing sugar percentage (10.77%) and the (U_2) minimum Non Reducing sugar percentage (10.50 %) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant.

Table 16: Combined effect of GA_3 and urea on non-reducing sugar % of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	10.64	11.00	10.27	10.63
U_1	10.81	11.17	10.34	10.77
U_2	10.51	10.87	10.12	10.50
Mean B	10.65	11.01	10.24	

Factors	C.D.	SEm±
Factor(U)	0.07	0.02
Factor(G)	0.07	0.02
Factor(U X G)	NS	0.04

Total sugar Percentage:

Total sugar percentage was recorded with the GA_3 and Urea spray and their combinations. Among the treatments, the treatment G_1 (18.12 %) gave significantly superior to other treatment i.e. G_0 (17.40 %) and G_2 (16.74 %). Where Urea spray (U_1) gave maximum Total sugar percentage (17.64 %) and the (U_2) minimum Total sugar percentage (17.23 %) found significantly superior to other treatments. The interactions of GA_3 and Urea spray were non-significant (Table 17).

Table 17: Combined effect of GA_3 and urea on Total sugar % (HCl) of mango cv. Langra

Treatment	G_0	G_1	G_2	Mean A
U_0	17.34	18.12	16.71	17.39
U_1	17.74	18.29	16.91	17.64
U_2	17.14	17.97	16.60	17.23
Mean B	17.40	18.12	16.74	

Factors	C.D.	SEm±
Factor(U)	0.32	0.11
Factor(G)	0.32	0.11
Factor(U X G)	NS	0.19

Phenological parameters

In the present research, spraying of GA_3@ 20ppm along with 4% urea spray proved the best where the date of first appearance of flowering was earliest on 19 January. Consequently the date of 50% flowering reached earliest on 19 February and full bloom of flowering on 9 March followed by GA_3@ 10ppm and 2% urea spray. Plant growth regulators and certain chemicals are known to activate the desired physiological modifications in fruit trees. Growth regulators are also known to play active role on growth modifications leading to earlier flowering, fruiting and maturity.

Flowering Behaviour:

The number of male and hermaphrodite flowers did not change upto significant extent due to different concentrations of GA_3 and urea spray on Langra mango. Accordingly the total (male + hermaphrodite) flowers at 20ppm GA_3 were lower (720.31/panicle) as against higher (745.01/panicle) at 10ppm GA_3. The reverse situation was true in case of urea spray. The total flowers at 2% urea were higher (737.51/panicle) as against lower (728.24/panicle) at 0% urea spray. The inverse relationship between $GA_3$and urea to activate flowering behaviour might be attributed to the differential action of GA_3as growth hormone and urea as nitrogenous fertilizer. Similar finding also Birendra *et al*. (2011).

Physical parameters:

The GA_3spray treatments influenced the Average weight of fruit,length and width of mango fruits significantly. Thus the maximum Average weight of fruit (220.63g),length (10.89cm) and width (6.39 cm) was recorded under 10ppmGA3, being significantly superior to 0 and 20 ppm GA_3 levels.

The increasing levels of urea spray upto 2% increased significantly all these physical parameters. Thus the maximum Average weight of fruit (218.12g),fruit length (10.48 cm) and fruit width (6.01 cm) were noted under 2% urea spray.

The best treatment interaction was 10ppmGA_3applied with 2% urea spray where the maximum fruit length was 11.04 cm, fruit width 6.54 cm and fruit weight 222.14g. In contrast the minimum parameters were noted in case of without $GA_3$and urea spray (9.19 cm length, 5.32 cm width and 210.19g fruit weight). It is apparent that the combined input of $GA_3$and urea further encouraged all these parameters synergistically. Their additive effect was eventual. Similar finding also reported by Parouha and Pandey (2019) and Sahu and Sahu (2020)

Among the physical parameters and the specific gravity was influenced significantly due to $GA_3$and urea spray as well as their interactions, but fibre content remained unchanged in the mango fruits. $GA_3$10ppm and urea 2% resulted in significantly higher specific gravity (1.05 to 1.00) over the remaining respective treatments. When both these chemicals applied together the specific gravity was further augmented upto 1.07. Similar finding also reported by Prasad (2012).

The pulp, peel and stone percentage in mango fruits did not change upto significant extent due to GA_3levels; however pulp,peel and stone percentages deviated significantly due to applied urea levels. This might have happened owing to differential physiological role of $GA_3$and urea which have got differential role of $GA_3$and urea which have got differential functional implication towards these physical parameters of mango fruits. Singh (2008) also found that spraying of plant growth regulators and chemicals.GA_3resulted in slightly higher pulp percentage over other treatments. The mechanism of action of GA_3 in delaying peel senescence and softening warrants further investigation. However for increase in pulp of fruit due to GA_3application, the probable reason may be that the gibberellins increases the cell wall hydrolyzing enzymes such as B1, 3 glucanase. Further there are sample evidences to show that GA_3caused

elongation. This is accompanied by increased synthesis of cell wall material and reorientation of cellulose microfarads. This confirms the findings of the Moneruzzaman et al. (2011).

Productivity parameters:

Different concentrations of GA_3influenced the productivity parameters significantly. Spraying of GA_3at 0 and 10ppm increased fruit yield (46.01 to 47.10kg/tree), being significantly superior to without GA_3spray. This may be owing to increased different sizes offruit settings per panicle as well as increased number of fruits/ plant as a result of GA_3Spray.

As regards with the different concentrations of urea spray, fruits yield was found significant. Thus urea spray upto 2% brought about significantly higher fruits yield (46.27 kg/tree) over the lower urea concentrations. Even 4% urea proved significantlyAs regards with the different concentrations of urea spray, fruits yield was significantly influenced. The increased fruits yield due to urea might be owing to increased different sizes of fruit settings per panicle. Consequently the increase in fruit yield due to 2% urea spray eventually was as a result of significant increase in the number of fruits perplant. Similar results have been reported byMoneruzzaman *et al.* (2011), Parouha and Pandey (2019) and Sahu and Sahu (2020)

Chemical parameters:

The total sugars reducing and non-reducing in mango fruits change due to $GA_3$and urea spray treatments. The rising trend of total sugar content of fruits during storage due to spray of PGK's and chemicals were observed by many researches(Choudhary *et al.* 2003) which might be due to more conversion of starch into sugar. The activity of $GA_3$and $Cacl_2$ activated this phenomenon notably (Singh, 2008). However, in the present research, the mango fruits were not stored, the total sugars were determined under pre- storage conditions hence there was no any change in this parameter due to $GA_3$and urea spray treatments. Similar results have been reported by Wahdan (2011)

There were no chances for the conversion of starch into sugar. There were no any changes in the TSS and acidity of the mango fruits due to different, concentrations of GA_3. However, urea spray brought about significant changes upto 2% recoded significantly higher TSS (22.39^0Brix) and significantly lowest acidity (0.26%). On the

other hand, the reverse trend wasobtained at 4% urea where TSS was significantly lowest (21.83^0Brix) and the acidity was significantly highest (0.28%). The increase in TSS content due to urea spray could have been due to further synthesis and accumulation of photosynthates in the mango fruits in the tree. GA_3did not change this parameter, however, found that the gradual increase in TSS in shelf life of mango treated with GA_3(50ppm) might be due to delay in ripening and senescence of mango fruits. It is also noted that TSS of mango fruits during storage was enhanced due to $CaCl_2$ (15%).Similar results have been reported by Moneruzzaman *et al.* (2011)

CONCLUSION:

The statistical analysis in the treatment was revealed that the treatment Interactions 10 ppm $GA_3$with 2% Urea spray performed the best where maximum fruit length, fruit width and fruit weight.Different concentrations of urea spray influenced only number of fruit/ plant significantly. Thus 2% urea spray formed significantly higher number of fruits. The findings allude that GA_3(10ppm) and urea spray (2%) have significant role in augmenting productivity and physico-chemical properties of mango fruits with minimum weight loss and spoilage of fruits. The finding alludes in the Total soluble solids 4% urea resulted in significantly highest and significantly lowest acidity over the lower dose of urea spray.

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