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Impact of chemicals on fruit set and yield contributing characteristics of mango (*Mangifera indica* L.) cv. Langra

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Abstract
In the present study entitled "Impact of chemicals on fruit set and yield contributing characteristics of mango (*Mangifera indica* L.) cv. Langra''. The trial was conducted in 2014-2015 in Bihar Agricultural University, Sabour, Bhagalpur, Bihar. The treatments comprised calcium nitrate @ 0.06%, boron @ 0.2%, sorbitol 2.0 %, urea 3.0 %, NAA 10 ppm, potassium nitrate @ 2.0% and including one as control (water spray). The results showed a remarkable influence of different chemicals on fruit set and yield. Foliar spray of calcium nitrate at 0.06% was found to be the best treatment among seven in terms of fruit yield, length, width and volume. Spraying of boron at 0.2% improved fruit regarding minimum fruit drop percentage. Regarding cost-benefit ratio calcium nitrate @ 0.06% shows the best effect followed by boron @0.02%.

Keywords: Mango, calcium nitrate, boron, potassium nitrate and B: C ratio

Introduction
Mango (*Mangifera indica L.*) is the principal fruit crop which comes under anacardiaceae family. It is most famous and choicest fruit of the tropics and subtropics commanding a unique position in Indian horticulture. It enjoys the status of king of fruits due to its delicacy, attractive appearance, fragrance, nutritive value and delicious taste. Langra is an essential commercial mango variety of North India. It is the biennial bearer and a mid-season variety, with good quality fruits. Flesh is firm, lemon yellow and scarcely fibrous. It has natural turpentine flavour. Improper flowering low fruit set as well as fruit retention leading to low yield and fruits of poor quality. In the former, the applied substances of nutrient are readily made available to the plant, which gives rise to quick results. On the other hand, in soil application availability of the applied mineral is best with different soil reactions and also mobility problem in the plant body. Calcium and boron have been found to induce best pollen germination and fruit set in mango [1]. Calcium is an essential nutrient as it is a constituent of cell wall a calcium pectate [2]. Carbohydrates play a vital role in pollen tube growth. Deficiency in carbohydrate metabolism in the anther leads to abnormal pollen development in many plants [3]. Sorbitol plays a decisive role in pollen viability, germination, fruit set, yield and quality of mango.

Several workers have suggested that foliar feeding (i.e. at the site of metabolism) of nutrients as a substitute or supplement to soil application considerably enhanced fruit yield and quality attributes [4]. Among mineral nutrients calcium, as a constituent of the cell wall, plays an essential role in forming cross-bridges. Which influence cell wall strength and is regarded as the last barrier to cell separation [5]. Boron increases pollen grains germination, and pollen tube elongation consequently leads to higher fruit set and finally the yield [6].

Positive role in pollen viability, germination, fruit set, yield and quality of mango. Among mineral nutrients, nitrogen is indispensable to the plant life and is involved in major biochemical reactions in them. Potassium has been known to influence fruit quality very efficiently and this element activates many enzymes. It regulates physiological processes such as translocation of solutes, transpiration, respiration and photosynthesis. Role of bioregulators is well established as they modify the plant processes. Exogenous application of NAA helps in minimising fruit drop, yield and quality of fruits. Considering these facts, the present study was undertaken to see the impact of foliar spray of certain chemicals like calcium, boron, sorbitol, urea, KNO_3 and NAA on fruit set, yield and quality of mango cultivar of Langra.

Material & Methods

An investigation "Impact of chemicals on fruit set and yield contributing characteristics of mango (*Mangifera indica L.*) cv. Langra" was conducted in All India Co-ordinated Research Project Sabour, Bhagalpur during 2014-15. All the trees were maintained under uniform cultural practices during the investigation. The treatments were calcium nitrate @0.06%, boron @0.2%, sorbitol @2.0%, urea @ 3.0%, NAA @10 ppm, potassium nitrate @2.0% and control in randomized block design with three replication. The spraying was done with the help of Gator sprayer in the early hours of the morning all parts of the foliar were drenched fully. The first spray was done at the time of 50 per cent flower bloomed in per panicle and second spray at the time of fruit set at the mustard size. Fruit length, width, fruit volume and yield per plant were recorded as per recommended methods.

Fruit Characteristics

Fruit characteristics included fruit yield/plant, fruit length, fruit width, volume of fruit. The number of fruits/plant was multiply by fruit weight and divided by thousand and their mean was calculated. Fruit length and width was estimated by the digital vernier calliper. The volume of fruits was measured after water displaced by each fruit, displayed water was measured in measuring cylinder. Water measuring in the measuring cylinder denotes the volume of the fruit.

Cost-benefit ratio for each treatment (for established orchard)

The economic studies of the crop were done by computing the cost of cultivation and net profit in rupees per hectare by the prevailing rate of inputs and output obtained from local market. The net return (Rs/ha) was calculated by subtracting the cost of cultivation from the gross profit derived from the sale proceeds of the harvested mango.

Results and Discussion

The data with regards to the yield of fruits per tree as influenced by the application of various chemicals were recorded and mean values are graphically displayed in Fig.1. Statistical analysis of the data indicated that effect of different substances enhancing yield was significant. From the perusal of the data, it appears that the fruit yield per tree was maximum (270.86 kg) with the spray of calcium nitrate at 0.06% followed by boron at 0.2% (T_2) i.e., 218.78 kg/tree. Next effective treatments in this regard were NAA 10 ppm (T_5) and potassium nitrate 2.0 percent (T_6) were found at the same fruiting. Minimum yield (143.07 kg) was recorded under control (T_7). Thus, by above findings, it can be derived that spraying of calcium nitrate at 0.06% was instrumental in increasing the yield of fruits per tree. However, boron at 0.2% was also very promising. It is apparent from the findings that different treatments of nutrients and bio-regulator produced a significant effect on yield of fruits. This might be due to that calcium spray well maintained that the middle lamella between plant cells, which lead to decrease fruit drop. Similar result was found by [7, 8]. Who reported that foliar spray of calcium nitrate at 2% recorded the highest number of fruit per tree. Calcium availability is essential in the biochemistry of plants and in the nitrogen fertiliser efficiency of surface-applied [9] also reported higher fruit set per panicle in Dashehari mango with calcium nitrate application [10]. found the parallel result in mango.

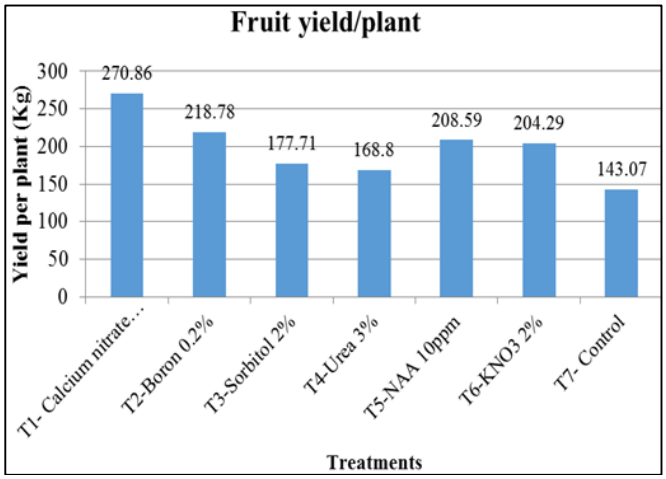

Fig 1: Impact of certain chemicals on fruit yield per plant (kg) of mango

Use of various nutrients and bio-regulators accelerated the development of fruits. The rate of growth was more under treated fruits than untreated ones. The maximum increase in length (9.35 cm), width (7.19 cm) and volume (278.99 cc) was observed with calcium nitrate at 0.06 %. Increase in fruit length, width and volume of fruit in the present study was probably due to increases in both in cell size and in the number of cells. Hence the process of cell elongation and cell division provides the basis for fruit growth. The division and enlargement of the cell is a complicated process involving a synthesis of many organic compounds such as protein, cellulose and nucleic acid [7] in mango.

The final length and width of fruits were recorded in cm at the time of harvesting and mean data, so obtained are depicted in Table-1. Statistical analysis of fruit of the data showed that different treatments were found non-significant in increasing the length and width of fruits.

Table 1: Impact of certain chemicals on yield contributing characteristics.

Treatments	Fruit yield per plant(kg)	Fruit length (cm)	Fruit width(cm)	Volume of fruit (cc)
T_1-Calcium nitrate 0.06%	270.86	9.35	7.19	278.99
T_2-Boron 0.2%	218.78	9.23	7.17	247.50
T_3-Sorbitol 2%	177.71	9.28	7.14	225.69
T_4-Urea 3%	168.80	9.18	7.11	217.50
T_5-NAA 10	208.59	9.29	6.98	232.25
T_6-KNO_3 2%	204.29	9.29	7.17	237.00
T_7- Control	143.07	9.27	7.07	212.75
CD at 5%	12.14	NS	NS	22.70

The volume of fruit was measured by water displacement method and was expressed in ml. The mean data, about the number of fruits under the influence of different treatments, have been presented in Table-1. The data obtained were computed statistically and analysis of variance reflected marked effects of different concentrations of nutrients and growth substance. Maximum fruit volume (278.99 cc) was obtained by spraying of calcium nitrate at 0.06% (T_1) followed by boron at 0.2% (247.50 cc). The next useful treatment in this regard was potassium nitrate at 2.0% (237.00 cc). The minimum volume of fruit (212.75 cc) was registered under control and remaining other treatments was found on the same footing. Thus, given above finding, it may be derived that spraying of calcium nitrate at 0.06% was most effective in increasing the volume of fruits. However, spray of boron at 0.2% was also found useful.

The data concerning the cost-benefit ratio for each treatment in cultivar Langra are provided in Table-2. In terms of cost-benefit ratio calcium nitrate @ 0.06% shows the best effect followed by boron @ 0.02%.

Table 2: Gross income, net income and B: C ratio of Mango cultivation during 2015 for the established orchard.

Treatment	Yield (q/ha)	Gross income Rs.	Total cost of cultivation (Rs/ha)	Net income Rs.	B:C ratio
Calciumnitrate @ 0.06%	270.86	1080000	110609	969391	8.76
Boron @ 0.2%	218.78	872000	109667	762333	6.95
Sorbitol @ 2%	182.91	731640	171733	559907	3.26
Urea @ 3%	168.80	672000	107959	564041	5.22
NAA @10ppm	208.59	834360	107663	726697	6.74
Potassiumnitrate @ 3%	204.29	817160	132133	685027	5.18
Control	143.06	572000	107533	464467	4.31

Conclusion

Therefore, it is concluded from the above results that to get a higher yield, fruit length, fruit width, and fruit volume of fruits, foliar spray of calcium nitrate at 0.06% was found to be the best treatment. Thus, indicate possibilities of successful use of plant growth substances and mineral nutrients to changes the growth behaviour, retention, yield and quality in mango. Further, an investigation with bio-regulators and mineral nutrients with other critical commercial cultivars of mango and also with other fruits may bring to light still more beneficial roles in respect of the development of fruit, fruit retention and better quality fruits.

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