International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **16**(03): 181-186, September 2023
DOI: 10.30954/0974-1712.03.2023.4

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Effect of Foliar Application of Growth Regulators and Micronutrients on Fruit Yield and Quality of Mango (*Mangifera indica* Linnaeus) *cv.* Mallika in Paklihawa, Rupandehi, Nepal

Netra Prasad Pokharel*, Pradip Gurung, Ganesh Prasad Kharel and Anita Parajuli

Institute of Agriculture and Animal Science, Paklihawa, Tribhuwan University, Nepal

*Corresponding author: netrapokharel73@gmail.com (**ORCID ID:** 0009-0001-9237-3992)

Paper No. 1089 **Received:** 10-06-2023 **Revised:** 21-08-2023 **Accepted:** 01-09-2023

ABSTRACT

The research experiment entitled "Effect of foliar application of growth regulators and micronutrients on fruit yield and quality of mango (*Mangifera indica* Linnaeus) *cv.* Mallika" was conducted at the Horticulture Orchard Institute of Agriculture and Animal Science (IAAS), Paklihawa, Rupandehi during March to July 2023. The experimental design was laid out in Randomized Complete Block Design (RCBD) with three replications and seven treatments. The different treatments used were T_1 (NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%), T_2 (NAA 20 mgl^{-1} + Borax 0.2%), T_3 (NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%), T_4 (NAA 40 mgl^{-1} + Borax 0.2%), T_5 (GA3 25 mgl^{-1} + $ZnSO_4$ 0.5%), T_6 (GA3 25 mgl^{-1} + Borax 0.2%), T_7 (Control – water spray). The foliar application of growth regulators and micronutrients were done at pea and fruit development stage of mango. The maximum fruit retention (9.81 %) and minimum fruit drop (90.18%) was observed on of NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%. The maximum average fruit weight (282.18 g), average stone weight (34 g), average peel weight (39.67 g), average pulp weight (208.51 g) and TSS (11.4° Brix) were observed on NAA @ 20 mgl^{-1} + $ZnSO_4$ @ 0.5% while maximum fruit yield per tree (9.36 kg per tree) was obtained in GA_3 @ 25 mgl^{-1} + Borax @ 0.2%. The aforementioned micronutrient and growth regulator combinations were also linked to fruiting characteristics and increased fruit production.

HIGHLIGHTS

- A combination of NAA @ 20 mgl^{-1} and $ZnSO_4$ @ 0.5% significantly reduces the fruit drop in mango and increase the quality.

Keywords: Mango, growth regulators, micronutrients, fruit drop, yield and quality

Mango (*Mangifera indica* Linnaeus) is one of the significant and well-known tropical fruit crops belonging to the family Anacardiaceae. It was the first tropical and sub-tropical fruit to be domesticated, now grown in more than 100 different nations including Southern Asia, particularly eastern India, Burma and the Andaman Islands. It is the second-most widely farmed tropical fruit and the sixth-largest fruit crop in the world (UNCTAD, 2016). Due to its color, scent, outstanding flavor, and nutritional content, it is also regarded as one of the most expensive and appealing tropical fruits and called "The king of fruits". Additionally, it is a great source of carbohydrates, minerals like Fe, P, Ca, and K, carotenoids, vitamins A, C, E, B, riboflavin, niacin, and thiamin (Maldonado-Celis *et al.* 2019). In Nepal, 51681 ha area are under mango cultivation and 43688 ha is the total productive

How to cite this article: Pokharel, N.P., Gurung, P., Kharel, G.P. and Parajuli, A. (2023). Effect of Foliar Application of Growth Regulators and Micronutrients on Fruit Yield and Quality of Mango (*Mangifera indica* Linnaeus) cv. Mallika in Paklihawa, Rupandehi, Nepal. *Int. J. Ag. Env. Biotech.*, **16**(03): 181-186.

Source of Support: None; **Conflict of Interest:** None

area from which 466266 Mt mangoes are produced with productivity of 10.67 Mt/ha (MoALD 2021). In Lumbini province, 6092 ha land is under mango cultivation with productivity of 8.55 Mt/ha, in which Rupandehi district contributes 600 ha of land under mango cultivation with productivity of 8.67 Mt/ha (MoALD 2021).

The enormous loss of fruits (99.9%) during various developmental phases is one of the most significant production bottlenecks for mangoes. The numerous drops go through natural stages. Additionally, it will be brought on by a few natural disasters. A key factor in mango fruit growth and fruit drop is naturally occurring hormones (Ram 1992). Fruit drop can be caused by a variety of factors, such as adverse weather patterns, poor fruit set, fruitlet competition, drought or inadequate irrigation, nutrient deficiencies, and the occurrence of harmful pests and diseases (Shainika & Tambe 2020). The increase in fruit quality could be attributed to the catalytic effect of micronutrients, especially when present in higher concentrations. Micronutrient foliar treatments accelerated the uptake of macronutrients in tissues and organs, which enhanced the quality of the fruit harvest (Anees *et al.* 2011). Foliar application of micronutrients and growth regulators is a standard practice to solve such deficits and enhance fruit quality. Micronutrients and plant bio-regulators applied topically have a significant positive impact on fruit set, production, and quality. Additionally, it helps fruit trees that have nutritional and physiological problems recuperate. To meet the functional need for nutrition, foliar treatment relies on the idea that nutrients are swiftly absorbed by leaves and distributed to various regions of the plant (Amrapali 2018). Zinc activates several metabolic enzymes, whereas gibberellin is primarily employed for regulating multiple physiological events and is commercially exploited to increase the quality of fruits. In addition, zinc plays a crucial role in the system of proteinases and peptidase enzymes. Zinc is utilized to encourage early flowering, which enhances fruit size, growth, and quality. The metabolism of hormones, photosynthetic processes, cellular development, and water absorption in plant sections are all thought to be fundamentally dependent on boron. Additionally, it participates in recombination, pollen tube germination, and fertilization (Chandra *et al.* 2022). Foliar application of nutrients is typically quicker for plants to absorb nutrients than soil application (Hasani *et al.* 2012). The experiment was conducted to examine the effects of various PGRs and micronutrients, on the fruiting, yield, and quality features of the mango cv. Mallika in Terai condition of Nepal.

METHODOLOGY

The research was conducted at Horticulture Orchard, Institute of Agriculture and Animal Science (IAAS), Paklihawa, Rupandehi, Nepal from March to July 2023 on a Mallika cultivar of mango. The selected trees for research purposes were almost 5 years old and uniform in size. The research experiment was set in a Randomized Complete Block Design (RCBD) with three replications and seven treatments. The treatments were T_1 (NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%), T_2 (NAA 20 mgl^{-1} + Borax 0.2%), T_3 (NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%), T_4 (NAA 40 mgl^{-1} + Borax 0.2%), T_5 (GA3 25 mgl^{-1} + $ZnSO_4$ 0.5%), T_6 (GA3 25 mgl^{-1} + Borax 0.2%), T_7 (Control – water spray). All the treatments were applied as a foliar spray at the pea and fruit development stage of the mango. The first and second application was done on 6^{th} April and 21^{st} April respectively. Before conducting research the canopy of tree covered with grasses were cleared and basin was formed around each tree. FYM 20 kg $plant^{-1}$ along with 100:100:100 gram NPK were applied and thoroughly irrigated. From each tree data were recorded in every fifteen-day interval till harvesting. The harvesting was done on July 15, 2023 and fruits were left at the central lab of IAAS Paklihawa campus at 22°C for uniform ripening and observations of change in peel color were done every day till it developed 100% yellow peel color. Three marketable fruits were randomly chosen from each experimental tree from each treatment, and their weights were recorded independently during harvest. The average fruit weight was reported in grams. The different observations recorded during the experiment were fruit drop percentage, fruit retention percentage, fruit weight, stone weight, peel weight, pulp weight, fruit length, fruit breadth, fruit yield per tree, firmness and quality parameters *viz.* Total Soluble Solids (TSS), Titrable Acidity (TA) and pH content of juice.

Utilizing the computer program R-studio (4.3.1), statistical analysis of the results was performed. Data were statistically examined using the analysis of variance (ANOVA) and the least significant difference (LSD) at the 5% level of probability was used to compare the significant difference between treatment means.

RESULTS AND DISCUSSION

Fruit drop and retention percent

There was a significant increase in fruit retention percentage and reduced fruit drop with the use of micronutrients and plant growth regulators (Table 1). The pre-harvest application of NAA 20 mgl^{-1} + $ZnSO_4$ 0.5% (9.81% and 90.18% respectively) was followed by the application of NAA 40 mgl^{-1} + Borax 0.2 % (9.39% and 90.61%, respectively) to achieve the highest fruit retention and the lowest fruit drop percentage. This increase in fruit retention and decrease in fruit drop percentage may be brought on by the plant's increased endogenous auxin and other metabolite levels as well as the inhibition of ABA production (Maurya *et al.* 2020). As a result, an exogenous application of auxin and gibberellins may have increased fruit retention and decreased drop percentage. The weakening and eventual fracture of the middle lamella of the cell in or near the abscission layer and low auxin levels cause the pre-harvest decline of mature fruits. Thus, adding auxin to the fruit stops these alterations in the middle lamella; this is probably accomplished by inhibiting the enzymes that make pectin soluble. Zinc sulfate applied topically to leaves in modest concentrations may aid plants in maintaining better nutritional status, which will ultimately enhance fruit retention and prevent drop (Tripathi 2020). Gami *et al.* (2019) reported increase in fruit set percentage with the application of NAA + KNO_3 + $ZnSO_4$ in Ber. The increase in fruit retention and decreased fruit drop in Dashehari mango with the application of NAA + GA_3 was reported by Darshan *et al.* (2022). Application of Zn + Ca + NAA + B in Alphonso variety of mango has higher fruit retention percentage as reported by Merwad *et al.* (2016).

Fruit size

There is significant variation in fruit size among different treatments. The highest fruit length and diameter were found in GA_3 @ 25 mgl^{-1} + Borax 0.2% (12.77 cm fruit length and 19.06 cm fruit diameter). The minimum fruit length (9.42 cm) and fruit diameter (15.16 cm) were observed in Control (water spray). The effective accumulation of metabolites in the early stages of developing fruits may be the cause of this increase in fruit size with spraying of plant bio-regulators and micronutrients. Spraying plant bio-regulators and micronutrients may have enhanced absorption and regulated cell-wall permeability, allowing more water to go through fruits and resulting in a larger fruit size. The results were in close conformity with the findings of Tripathi and Tiwari (2015) who reported increased fruit size of mango with application of GA_3@ 50 ppm. The findings are in line with Kumar *et al.* (2018) in mango, Bhadauria *et al.* (2018), and

Table 1: Effect of micronutrients and plant growth regulators on fruit drop and retention percentage

Treatment number	Treatments	Fruit Drop (%)	Fruit retention (%)
T_1	NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%	90.18^a	9.81^a
T_2	NAA 20 mgl^{-1} + Borax 0.2%	95.52^a	4.48^a
T_3	NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%	92.38^a	7.62^a
T_4	NAA 40 mgl^{-1} + Borax 0.2 %	90.61^a	9.39^a
T_5	GA3 25 mgl^{-1} + $ZnSO_4$ 0.5 %	96.92^a	3.08^a
T_6	GA3 25 mgl^{-1} + Borax 0.2%	91.09^a	8.91^a
T_7	Control (water Spray)	98.29^a	1.71^a
SEm (±=)		0.98	0.98
LSD(0.05)		9.03	9.03
CV (%)		5.42	78.99
F probability		ns	ns
Grand mean		93.57	6.43

Note: *SEm = Standard error of mean, LSD = Least Significant Difference, CV = Coefficient of Variations, s = Significant, ns = Non-significant. Treatments means are separated by Least Significant difference (LSD) and the columns are represented by the same letter(s) and are non-significantly different from each other at a 5 % level of significance.*

Table 2: Effect of plant growth regulators and micronutrients on physical parameters of mango

Treatment number	Treatments	Fruit Length (cm)	Fruit Diameter (cm)
T_1	NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%	12.57[a]	17.56[ab]
T_2	NAA 20 mgl^{-1} + Borax 0.2%	11.21[ab]	17.45[ab]
T_3	NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%	10.73[ab]	16.34[ab]
T_4	NAA 40 mgl^{-1} + Borax 0.2%	11.78[a]	16.15[ab]
T_5	GA3 25 mgl^{-1} + $ZnSO_4$ 0.5%	11.76[a]	18.11[ab]
T_6	GA3 25 mgl^{-1} + Borax 0.2%	12.77[a]	19.06[a]
T_7	Control (water Spray)	9.42[b]	15.16[b]
SEm (±=)		0.23	0.34
LSD(0.05)		2.12	3.14
CV (%)		10.39	10.32
F probability		s	ns
Grand mean		11.46	17.12

Note: *SEm = Standard error of mean, LSD = Least Significant Difference, CV = Coefficient of Variations, s = Significant, ns = Non-significant. Treatments means are separated by Least Significant difference (LSD) and the columns are represented by the same letter(s) and are non-significantly different from each other at a 5 % level of significance.*

Table 3: Effect of plant growth regulators and micronutrients on fruit yield of mango

Treatments	Average fruit weight (g)	Average stone weight (g)	Average peel weight (g)	Average pulp weight (g)	Fruit Yield per tree (kg)
NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%	282.18[a]	34[a]	39.67[a]	208.51[a]	9.28[a]
NAA 20 mgl^{-1} + Borax 0.2%	213.08[ab]	24.67[bc]	32[abc]	156.41[a]	8.6[a]
NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%	210.64[ab]	22[c]	31[bc]	157.63[a]	8.76[a]
NAA 40 mgl^{-1} + Borax 0.2%	213.91[ab]	24.67[bc]	29.67[bc]	159.58[a]	9.09[a]
GA3 25 mgl^{-1} + $ZnSO_4$ 0.5 %	221.29[ab]	25.67[bc]	29[bc]	166.63[a]	7.59[a]
GA3 25 mgl^{-1} + Borax 0.2%	267.29[ab]	30.33[ab]	35.67[ab]	201.29[a]	9.36[a]
Control (water spray)	192.12[b]	19.33[c]	26.33[c]	146.45[a]	7.10[a]
SEm (±=)	8.36	0.88	0.86	7.53	0.33
LSD(0.05)	77.31	8.11	7.93	69.65	3.049
CV (%)	19.00	17.67	13.97	22.90	20.066
F probability	ns	s	s	ns	s
Grand mean	228.64	25.81	31.90	170.93	8.54

Note: *SEm = Standard error of mean, LSD = Least Significant Difference, CV = Coefficient of Variations, s = Significant, ns = Non-significant. Treatments means are separated by Least Significant difference (LSD) and the columns are represented by the same letter(s) and are non-significantly different from each other at a 5 % level of significance.*

Tripathi (2018) in aonla and Tripathi and Shukla (2020) in strawberry.

Fruit Yield

There is a significant difference on fruit weight, stone weight, peel weight among treatments were found but no significant difference found in pulp weight and fruit yield per tree (Table 3). The average fruit weight (282.18 g), average stone weight (34 g), average peel weight (39.67 g) and average pulp weight (208.51 g) were found maximum in NAA @ 20 mgl^{-1} + $ZnSO_4$@ 0.5% followed by GA3 @ 25 mgl^{-1} + Borax @ 0.2%. The minimum average fruit size (192.12 g), average stone weight (19.33 g), average peel weight (26.33 g), and average pulp weight (146.45 g) were found in control (water spray). The Fruit yield per tree was found maximum in GA3 @ 25 mgl^{-1} + Borax @ 0.2% (i.e. 9.36 kg per tree) followed by NAA @ 20 mgl^{-1} + $ZnSO_4$@ 0.5%. The minimum fruit yield per tree was found in control (i.e. 7.10 kg per tree) (Table 3). The increase in fruit output brought on by the foliar feeding of micronutrients and plant bio-regulators by plant leaves may be linked to earlier, more luxuriant vegetative growth, which later leads to the synthesis

Table 4: Effect of plant growth regulators and micronutrients in quality parameters of mango

Treatments	Total Soluble Solids (^{0} Brix)	Titratable Acidity (TA)	PH
NAA 20 mgl^{-1} + $ZnSO_4$ 0.5%	11.4^a	0.0519^b	4.73^b
NAA 20 mgl^{-1} + Borax 0.2%	9.93^{abc}	0.0329^{de}	4.22^e
NAA 40 mgl^{-1} + $ZnSO_4$ 0.5%	10.93^a	0.04^c	4.69^{bc}
NAA 40 mgl^{-1} + Borax 0.2 %	10.73^{ab}	0.0368^{cd}	4.5^d
GA3 25 mgl^{-1} + $ZnSO_4$ 0.5 %	8.57^c	0.041^c	4.64^{bcd}
GA3 25 mgl^{-1} + Borax 0.2%	9.87^{abc}	0.0298^e	4.59^{cd}
Control (water Spray)	9.20^{bc}	0.0723^a	4.90^a
SEm (±=)	0.17	0.000674	0.015
LSD(0.05)	1.57	0.00622	0.0135
CV (%)	8.77	8.038	1.65
F probability	s	s	s
Grand mean	10.09	0.0435	4.61

Note: *SEm = Standard error of mean, LSD = Least Significant Difference, CV = Coefficient of Variations, s = Significant, ns = Non-significant. Treatments means are separated by Least Significant Difference (LSD) and the columns are represented by same letter(s) are non-significantly different among each other at 5 % level of significance.*

of more metabolites for developing fruits. The increased yield of litchi with the application of Borax @ 0.5% was reported by Gupta *et al.* (2022). Similar findings were reported by Tripathi and Tiwari (2015) in mango, Dhakad *et al.* (2020) in mulberry, Weight (2005) in strawberry and Badal and Tripathi (2021) in guava.

Quality parameters

A maximum amount of total soluble solids (TSS) was found in the fruits treated with NAA @ 20 mgl^{-1} + $ZnSO_4$ @ 0.5% (11.4° Brix) followed by NAA @ 40 mgl^{-1} + $ZnSO_4$ @ 0.5% (10.93° Brix). Similarly, the maximum titratable acidity percent (0.0723%) and PH (4.90) were recorded in fruits which were produced from the plants kept under control while minimum titratable acidity (0.0298%) was recorded from GA_3 @ 25 mgl^{-1} + Borax @ 0.2% and minimum PH (4.22) was recorded from NAA @ 20 mgl^{-1} + Borax @ 0.2% (Table 4). Increased content in total soluble solids in fruits may be the result of enough NAA levels improving the auxin content, which catalyzed the oxidation process. The increased active role that borax and zinc played in the mobilization of food material may have contributed to the accumulation of quality ingredients like carbohydrates, which in turn helped to enhance the quality attributes, as seen by the increase in TSS. This is in close conformity with the results of Dhakad *et al.* (2020) in mulberry, Liaquat *et al.* (2023) in mandarin fruits.

Utilizing a plant bio-regulator and micronutrients reduced the titratable acidity content of fresh fruits. This could result from an increase in the metabolic conversion of acids to sugars by the reversal reaction of the glycolytic pathway, which is used in numerous physiological functions, as well as an increase in the translocation of photosynthates (carbohydrates). The similar results were reported by Gupta *et al.* (2022) in litchi, Tripathi (2018) in Aonla.

CONCLUSION

The pre-harvest application of growth regulators and micronutrients has been experimented on mango to improve the fruit yield and quality. In above experiment, the combination of NAA @ 20 mgl^{-1} and $ZnSO_4$ @ 0.5% gives greater significance over other treatments. The further investigation with growth regulators and micronutrients alone or by combining these in suitable proportion will be done to reduce fruit drop thereby increasing the yield and quality.

ACKNOWLEDGMENTS

We would like to thank the Institute of Agriculture and Animal Science (IAAS), Paklihawa, Tribhuwan University (TU), and the Department of Horticulture for providing us with all the necessary equipment and materials for conducting this experiment. We would also like to thank our lab assistant, Mr.

Rupesh Singh, for his continuous help and guidance.

REFERENCES

Amrapali, L.F.C.V. 2018. *Achieving Higher Yield and Quality of Mango (Mangifera indica)*. June 2020.

Anees, M., Tahir, F.M., Shahzad, J., Mahmood, N. and Genetics, M. 2011. Effect of foliar application of micronutrients on the quality of mango (*Mangifera indica* L.) cv. Dusehri fruit. *Mycopathology*, **9**(1): 25–28.

Badal, D.S. and Tripathi, V.K. 2021. *Influence of Foliar Feeding of NAA and Boron on Growth, Flowering, Fruiting, and Yield of Winter Season Guava (Psidium guajava L.) cv . L – 49*. **13**(3): 387–391.

Bhadauria, A.S., Tripathi, V.K., Singh, A. and Gupta, S. 2018. *Effect of foliar application of plant bio-regulators and micro-nutrients on fruit retention, yield and quality attributes of aonla*. **13**: 216–219.

Chandra, V.K.T., Azad, S., Gupta, A., Tripathi, V.K. and Shukla, J.K. 2022. Influence of GA3, Zinc and Boron on Fruit drop, Yield and Quality of Litchi (*Litchi chinensis* Sonn.). *Biological Forum-An Int. J.*, **14**(3): 1079.

Darshan, D., Hota, D., Devi, R. and Shukla, J.K. 2022. *Micronutrients and plant growth regulators affecting the yield and quality of fruit crops: A review*, **8**: 92–103.

Dhakad, A., Baloda, S., Sehrawat, S.K. and Sharma, J.R. 2020. *Effect of NAA and zinc sulphate application on fruit drop, yield and quality attributes of mulberry (Morus alba L.)*. **9**(6): 1937–1943.

Gami, J., Sonkar, P., Haldar, A. and Patidar, D.K. 2019. *Effect of Pre-harvest Spray of* $ZnSO_4$*,* KNO_3 *and NAA on Growth, Yield and Quality of Ber (Zizyphus mauritiana Lamk.) cv. Seb under TSS / acid ratio = Total Soluble Solids / Acidity*, **8**(03): 1977–1984.

Gupta, A., Tripathi, V.K. and Shukla, J.K. 2022. *Influence of GA3, Zinc and Boron on Fruit drop, Yield and Quality of Litchi (Litchi chinensis Sonn.)*, **14**(3): 1079–1083.

Hasani, M., Zamani, Z., Savaghebi, G. and Fatahi, R. 2012. Effects of zinc and manganese as foliar spray on pomegranate yield, fruit quality and leaf minerals. *J. of Soil Sci. and Plant Nutri.*, **12**(3): 471–480.

Kumar, A., Gowda, V., Shetty, S., Tripathi, V.K., Tomar, S., Tomar, R., Srivastava, A.K., Kala, D.C., Kumar, P., Khare, N., Rout, S., Dwivedi, R.K., Srivastava, A.S., Chaudhary, K., Shehrawat, P.S., Khan, M., Painkra, K.L. and Painkra, G.P. 2018. *J. of Plant Dev. Sci.*, **10**(11).

Liaquat, M., Ali, I., Ahmad, S., Malik, A.M., Ashraf, H.M.Q., Parveen, N., Tareen, M.J., Saeed, T., Shah, S.H. and Zulfiqar, B. 2023. *Efficiency of exogenous zinc sulfate application reduced fruit drop and improved antioxidant activity of 'Kinnow' mandarin fruit*, **83**: 1–8.

Maldonado-Celis, M.E., Yahia, E.M., Bedoya, R., Landázuri, P., Loango, N., Aguillón, J., Restrepo, B. and Guerrero Ospina, J.C. 2019. Chemical Composition of Mango (*Mangifera indica* L.) Fruit: Nutritional and Phytochemical Compounds. *Frontiers in Plant Sci.*, **10**: 1–21.

Maurya, P.K., Tripathi, V.K. and Gupta, S. 2020. *Effect of pre-harvest application of GA3, Naphthalene acetic acid and borax on fruit drop, yield and quality of Mango cv. Amrapali*, **9**(6): 2123–2127.

Merwad, M.A., Eisa, R.A. and Saleh, M.M.S. 2016. The beneficial effect of NAA, Zn, Ca and B on fruiting, yield and fruit quality of Alphonso mango trees. *Intl. J. Chemtech. Res.*, **9**(3): 147-157.

MoALD, 2021. Statistical Information on Nepalese Agriculture (2077/78). *Publicatons of the Nepal in Data Portal*, **73**: 274. https://nepalindata.com/resource/statistical-information-nepalese-agriculture-207374-201617/

Ram, S. 1992. Naturally Occurring Hormones of Mango and Their Role in Growth and Drop of the Fruit. In *Acta Horticulturae* (Issue 321, pp. 400–411). https://doi.org/10.17660/actahortic.1992.321.43

Shainika, S. and Tambe, D.T. 2020. Effect of plant growth regulators and micronutrients on flower and fruit retention in mango (*Mangifera indica* L.) CV. Kesar. *Int. J. of Chem. Stud.*, **8**(4): 3716–3719. https://doi.org/10.22271/chemi.2020.v8.i4au.10223

Tripathi, V.K. 2018. *Influence of foliar application of gibberellic acid, calcium and boron on fruit drop, yield and quality attributes of aonla (Emblica officinali) cv. NA 7 Influence of foliar application of gibberellic acid, calcium and boron on fruit drop, yield and quality attributes of aonla (Emblica officinalis) cv. NA 7. July 2020*. https://doi.org/10.56093/ijas.v88i11.84931

Tripathi, V.K. 2020. *"Influence of NAA and zinc sulphate on fruit set, fruit drop, cracking, fruit size, yield and quality of litchi cv. Calcuttia."* July 2010.

Tripathi, V.K. and Shukla, P.K. 2020. *Influence of plant bio-regulators, boric acid and zinc sulphate on yield and fruit characters of Strawberry cv. Chandler Influence of plant bio-regulators, boric acid and zinc sulphate on yield and fruit characters of Strawberry cv. Chandler. July*. https://doi.org/10.13140/RG.2.2.24585.47209

Tripathi, V.K. and Tiwari, P. 2015. *Influence of Pre-harvest Application of Plant Bio-regulators and Micro Nutrients on Fruit Retention, Yield and Quality Attributes influence of Pre-harvest application of Plant Bio-regulators and Micro Nutrients on Fruit Retention, Yield and Quality Attributes of July*. https://doi.org/10.13140/RG.2.2.15358.00329

UNCTAD. 2016. Mango, UNICTAD. *United Nations Conference on Trade and Development*. http://en.calameo.com/read/00344026960f7ef6985a5

Weight, B. 2005. *Effect of Zinc and Iron on Growth, Yield and Quality of Strawberry cv.* 1993, 237–240.